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ENGINEERING NEWS.

MISSISSIPPI RIVER IMPROVEMENT is being discussed before the United States Senate Committee on Commerce. Gen. COMSTOCK, Chairman of the Mississippi River Commissions, said that the general plan adopted by the commission was to contract the river to an average width of 3,500 ft., whereas its natural width in some places is as much as two miles. The purpose is to deepen the low water channel, and he says the results so far have been satisfactory. He objected to the Lake Borgne outlet scheme as liable to shoal the river below New Orleans. The levees built by the commission had cost about $3,000,000; but he objected to levees as aids to navigation as well as safeguards against floods, as this would cost $75,000,000. Capt. S. S. LEACH, U. S. Eng. Corps, who has been on Mississippi River work since 1878, said that all the present breaks could be repaired for $100,000, and that the experience of this year would make it safe to start a scheme of building absolutely impregnable levees for $10,000,000. The entire Mississippi could be handsomely improved for $50,000,000.

THE BRAZOS RIVER IMPROVEMENT is a success, to this point at least, writes Mr. GEORGE Y. WISNER, the chief engineer. Mr. WISNER says that while the jetties are yet nearly 1,000 ft. inside the bar, the recent rise in the Brazos has excavated a channel 22 to 30 ft. deep through the entire length of the jetties and for over 900 ft. beyond the outer end of the works. The channel across the bar is 13 ft. deep, and is still deepening. This bar is only about 100 ft. wide on the crest, and has not been pushed seaward, as in all former rises. The discharge of the river is about 60,000 cu. ft. per second, and about 300,000 cu. yds. of sediment is moved per day. The amount of excavation in the jetty channel and river immediately above the jetties has been over 700,000 cu. yds. All of this material has been carried into the Gulf and disposed of beyond the bar without pushing the bar itself seaward, thus conclusively showing that the Gulf currents are capable of taking care of all the material that may be thrown out by the river in the future.

THE ARTESIAN BELT OF THE JAMES RIVER VALLEY, DAKOTA, says the irrigation committee at Washington, is the largest water body of its character known to the world. The James River takes its rise in the Devil's Lake basin, and runs for over 400 miles almost due southward until it enters the Missouri River at Yankton, where the artesian belt has so far reached its largest development. The area thus embraced is at least 50 miles in average width. It contains about 7,000,000 acres, of which certainly 98 per cent. could be made available for tillage. From Jamestown, N. D., about 50 miles above the northern line of South Dakota to Yankton, in the extreme southern part of the same State, there are now about 50 artesian town wells in operation, striking water at a depth that ranges from 1,577 ft. in Jamestown to 610 and 600 ft. at Yankton and Frankfort. There are in all nearly or quite 100 flowing wells in South Dakota, though all but those named as town wells are usually of small bore, and were sunk for farm purposes only. The remarkable features of this belt of artesian water are its quantity, force and continuance. The pressure of the principal wells is from 25 lbs. to the sq. in. at Highmore to 170 at Yankton, where five wells supply the town with water for domestic uses, town purposes and as power for manufacturing. The flow of water ranges per minute from 4,000 galls. at Columbia, 3,500 at Aberdeen, 1,500 at Yankton, down to 14 at Highmore. The cost of sinking such wells ranges from $2,700 to $7,300. If the business were systematized the cost may probably be not over $1,500 each. The altitude ranges from 1,900 at Yankton to 1,000 ft. above sea level at Grafton.

THE CINCINNATI WATER-WORKS are in a very bad way, as far as its pumping engines at the Front St. Station are concerned. The Shield engine, the largest at the works, with an original capacity of 17,000,000 galls. in 24 hours, has dwindled down to 5,000,000 galls. in the same period; and one of the two Scowden engines broke its piston rod this week. The Wetherill 8,000,000 gall. engine is reported as doing fair service. A board of experts are at work trying to locate the trouble in the big Shield engine; but, from the Cincinnati press accounts, and in view of past trouble with these same engines, it looks as if the best thing to do would be to put Mr. G. BOUSCAREN, or some equally good engineer, in charge, and have this antiquated machinery replaced by more modern and efficient pumps.

THE LONDON HYDRAULIC POWER CO., according to its last report, had 814 motors supplied in December, 1888 and 1022 in December, 1889. In the former year, 285 motors were set up, in the latter 208. The amount of water handled by the pumps in 1888 was 12,000,000 galls., in 1889, 16,400,000 galls. The price per 1,000 gallons was 73 cents in 1888 and 78 cents in 1889. Last year a dividend of 5.25 per cent. was declared.

THE SUSPENSION BRIDGE AT BUDA-PESTH is said to be in danger. The Dutch engineer, HAENTJENS, recently called the attention of the Hungarian government to the rust that had eaten into parts of the anchors. He soon convinced the authorities that the famous structure was not safe, and has been engaged by them to draw up a plan for repairing it.

THE NEEDLES BRIDGE, over the Colorado river at Needles, Cal., was practically opened by the passage of a train on May 10. This bridge, built by the Atlantic & Pacific R. R. Co., is a cantilever, 900 ft. long, with 660 ft. between the main piers.

THE HUDSON RIVER BRIDGE BILL, known as the Greene bill, has become a law by lapse of time without the signature of Gov. HILL. It provides for erecting what is practically Mr. LINDENTHAL'S bridge at New York, a central span of 2,850 ft., and six tracks, with room for ten, being provided. It is not in the interest of the LINDENTHAL bridge which is now before Congress, but so far as appears upon the surface is a mere "strike," to get a certain control of a valuable franchise and sell out. Should the LINDENTHAL bill pass Congress, however, it will require no State action to confirm it, while the New York bill is worthless without concurrent action by both New Jersey and Congress.

THE GROSS EARNINGS OF 131 RAILWAYS for the month of April 1890, according to statistics collected by *Bradstreet's*, are $29,759,015, an increase of 14 per cent. over the earnings for the same period of 1889. The detailed tables show that this increase has been, on the whole, very uniform, a state of affairs which would hardly be expected, considering the rate wars in the Northwest and the disastrous floods of the South. The lines showing decreases are nearly all roads of minor importance; the great systems showing an almost uniform increase in earnings. The Granger roads all show increases showing that the increased traffic has counteracted the effect of the rate wars upon the gross earnings. The exact effect of the rate wars upon the income of these roads cannot be seen, however, until the net earnings are made known. The effect of the floods upon the Southern roads seems to have been but little. The other groups show heavy increases in all cases.

THE WESTERN RY. OF FRANCE has recently increased the sections of its rails. Formerly the 80-lb. double-head rail, used for many years in England, was alone employed. Now the depth of the head has been increased by 0.47 in., the other dimensions remaining the same. The same chairs that have been used are retained, since no alteration in the base has been made. The new rail is 5.52 ins. high, 2.44 ins. broad at the head, has a neck of 0.71 in., and weighs nearly 89 lbs. They are about 39.4 ft. long. The angle-bars used with them weigh 37.5 lbs. a pair.

FUSEE SIGNALS are to be used on the passenger trains of the New York Central R. R. to avoid rear collisions. An order has been issued requiring that such trains shall carry a tin box with different colored fusees with the usual torpedoes and flags for day use. In case of a break-down or sudden stoppage of a train the fusees can be thrown off the rear platform so as to instantly warn the engineer of the following train there is danger ahead. Should a train be losing time, a fusee can be lighted and dropped upon the track. Even in a heavy storm the burning fusee will light up the track very brilliantly. The fusees are made to burn eight, ten and twelve minutes.

THE AVERAGE SPEED OF CONTINENTAL EXPRESS TRAINS, including stops, according to the *Zeitung des Eisenbahn Vereines*, was for 1888 as follows: Prussian local lines, 30.944 miles per hour; North Germany, 30.82 miles; Holland, 30.757 miles; France, 30.013 miles, and Belgium, 29.700 miles per hour.

THE AMERICAN LOCOMOTIVE will apparently not be well represented at the Edinburgh exhibition this year. We learn, however, that there is still accommodation for photographs and engravings, and it might be well for American locomotive builders to make such exhibits for the benefit of their foreign trade, especially for South America. For particulars address Mr. GEO. E. WATSON, Secretary of the International Exhibition, Edinburgh, Scotland.

THE MILLER COUPLER SUIT against the Pennsylvania Railroad is now on trial in the U. S. Circuit Court. It is brought by the heirs of EZRA MILLER, the inventor of the coupler which bears his name, on the ground that the Janney platform and coupler are an infringement of the Miller. The suit affects not only the Pennsylvania but many other roads. The defense is that the Janney does not infringe the Miller, that EZRA MILLER authorized what infringe there is, and the statute of limitations from Oct. 10, 1882.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a grade-crossing collision at Allentown, Pa., May 7. The accident occurred at the Union St. crossing of the Lehigh Valley and Allentown Terminal railroads. The Jersey Central flyer, owing to a defective air-brake, dashed into the Buffalo express, bound east. Two persons were killed. The Buffalo express was two hours late. It approached the crossing under control, and was given the signal to proceed. The Jersey Central express came around the curve a block away, at a high rate of speed. The engineer applied the brakes, but they failed to respond. He then reversed his engine, but it was too late. The locomotive dashed into the side of a Lehigh Valley coach, cutting a hole in it and upsetting it on its side. This was followed by another, which landed it on top of the first car. Both cars were thrown into Union St. The locomotive also left the rails, and was turned almost completely around. Such accidents show how slowly railway companies are acting in protecting their track crossings. In spite of many warnings there are numbers of crossings at grade which are left in this dangerous condition.——Another serious accident was a head collision May 12 between two freight trains on the East Tennessee, Virginia & Georgia R. R. at Jersey Switch, near Chattanooga, Tenn. Both engines and 25 cars were wrecked. Five men were killed. This accident, like so many other

freight train collisions, was due to a misunderstanding of orders.

A SERIOUS DERAILMENT accident occurred May 9, on the Chicago, Burlington & Quincy R. R., near the west end of the main Bureau bridge, about four miles from Wyanet, Ill. The engine in passing over the derailing switch left the track and ran along the ground for about 100 ft., when it tipped over. The first car was driven into the cab of the engine. Three men were killed. It is said that heavy rains had caused the track to settle on one side at the derailing switch and that this caused the accident.

BRIDGE ACCIDENTS are reported as follows:

On May 3, a railway bridge near Mosier, Ore., was destroyed by fire.——On May 4, 12 cars of a freight train went through a burned bridge at Holly, Minn. ——A bridge at Le Mars, Ia., gave way May 4, under an Illinois Central freight train; 13 cars went down.——The bridge of the American Midland Ry., over the Blanchard River, between Ottawa and Findlay, O., was washed away by a flood on May 12.

TWO LOCOMOTIVE BOILER EXPLOSIONS are reported: The boiler of a Lehigh Valley freight engine exploded May 11, while the engine was hauling a train of 27 cars at slow speed near Buffalo Creek Junction. The engine was wrecked and the driver and fireman were killed. The boiler of a Philadelphia & Reading freight engine exploded May 13 while near Paxinos, Pa. The engine was wrecked and two men were killed.

A REMARKABLE BOILER EXPLOSION happened to Lehigh Valley Locomotive No. 261, on May 11. It was slowly hauling a train of 27 cars when every part of it but its truck and driving wheels disappeared with a terrific roar, the fragments being thrown 100 to 400 ft., the track badly torn up, and the bodies of the engineman and fireman thrown 1,000 and 500 ft. off respectively. Almost every fragment of the engine above the wheels was blown away. No cause for the explosion is known or discoverable.

A TORNADO struck Akron, O., on May 10, and caused considerable damage. Its path is stated to have been from 50 to 150 ft. wide.

THE SENATE IRRIGATION COMMITTEE in its report, says that more than two-fifths of the area of the United States, including Alaska, requires irrigation to insure regular crops. With dams and reservoirs at suitable places a large extent of this region could be made productive and the floods of the lower Mississippi alleviated. The process of irrigation could be aided by boring artesian wells. All of the country west of the eastern base of the Rocky mountains requires irrigation except a part of Washington, Oregon and Northern California west of the Cascade mountains, and small areas in eastern Oregon, Washington and Northern Idaho. The committee submit in conclusion an estimate of the areas under cultivation. From this it seems that the area under ditch is 13,560,000 acres, of which 4,000,000 is in California and 3,000,000 in Colorado. The amount cultivated by irrigation is 7,763,000, of which 3,300,000 is in California and 1,600,000 is in Colorado. Projects under way and partly completed will bring the acreage under ditch up to 15,000,000 acres. The total value of reclaimed land is nearly $700,000,000. Allowing for the reclaimability of 100,000,000 acres of arid land and we have a result total of real estate of the value of $2,500,000,000.

Mr. REAGAN submits a minority report disagreeing with most of the conclusions of the majority and recommending Congressional action diametrically opposed. The minority says that the lands embrace an area of 1,340,000 sq. miles, of which 100,000,000 acres can be redeemed for agriculture by using the total supply of perennial streams. The minority recommends the adoption of a system of measuring waters used for irrigation to prevent waste. They urge the necessity of protecting the forests, which are being rapidly burned, and also pasturage lands. Irrigable lands should be segregated and declared such, and the right to use water on them established and a prohibition put on the use of water on other lands. Irrigation districts should be established, and the farmers on these lands should control the receiving areas, with all their values. The minority believe the recommendations to discontinue the topographic work of survey and boring for artesian water unwise.

The New Water Supply for Covington, Ky.

(WITH INSET.)

Covington derives its water supply from the Ohio River since 1870, when the old works, designed on the "Holly system" plan, were built on the bank of the river at the foot of Main Street. It had been intended to pump from a well sunk in the sand and gravel which overlies the blue shale and limestone, with the idea of obtaining river water by natural filtration, but the water proved to be hard, of strong chalybeate taste and insufficient in quantity to supply the pumps; the well was abandoned and a cast iron conduit was laid to take water directly from the river.

From the fact that the Ohio River, and the Licking coming into it less than a mile above the pumping station, receive the drainage and sewerage of Cincinnati, Covington, Newport and several towns and villages, aggregating, probably, a population of over two hundred and fifty thousand (250,000) within a distance of four miles above the intake, an idea can be formed of the quality of the water delivered to the citizens of Covington. Besides, the water being pumped directly into the distributing system, the mains have long since become fouled with the deposits from the turbid Ohio waters, rendering it extremely difficult to maintain the pressure required for fire protection, causing frequent break-downs in the machinery, and increasing greatly the cost of pumping.

In designing the new works, the objects in view have been, to obtain the best water procurable from the Ohio river, to clarify the same by subsidence in a reservoir of sufficient capacity to answer the purpose for a long period of time, and located at a sufficient elevation to afford a static pressure of not less than 100 lbs. per square inch, in the business part of the city.

This could have been accomplished at a comparatively small cost by remodelling the existing waterworks of Newport, but, unfortunately, a hostile spirit of rivalry between the two corporations so blinded their business sense in this instance as to render the proposed scheme of consolidation impracticable.

In the inset issued last week is a map giving the general topographical lines of the country surrounding Covington, showing the location of the new pumping station, reservoir and pipe line.

The pumps are located about 8 miles above the old works, at a point entirely clear of possible contamination from the group of cities and towns, of which Cincinnati is the center. The water is taken from the river channel through an aqueduct 4 ft. in diameter, and is delivered through a 30-in. main, 5,478 ft. long, into 2 settling basins built on the same level, the aggregate capacity of which is 57,500,000 galls. The elevation of the water level in these basins varies from 336 ft. to 366 ft. above low water in the river at the pumping station.

The water is decanted from the settling basins into a distributing basin of 27,000,000 galls. capacity, 25 ft. below them. From hence it is again drawn by decantation, and delivered to the city through a 30-in. conduit, 19,996 ft. long, extended through the city with a 24-in. main, 2,287 ft. long and a 20-in. main, 8,273 ft. long.

Plans and cross sections of the pumping station, the plan of the reservoir, etc., were given in our last week's inset.

At the point where the house is located, the Kentucky bluffs spring directly from the river bank, the Chesapeake & Ohio R. R., recently built, occupying the foot of the bluff. For reasons of economy and safety arising from the great variation of the water level (69 ft. between extreme low and high water marks), and the swift current freighted with heavy drifts at high stages, the house is built as near the railroad as practicable; it is 94 ft. 7 ins. long and 83 ft. 6 ins. wide, the longest side facing the river; it is built of brick on foundation walls of sandstone masonry, carried down through about 15 ft. of clay and loose rock, to the stratified blue shale and limestone. It is divided by a partition wall extending to the roof, into an engine room and a boiler room. The floor, 15½ ins. above extreme high water, built of I-beams and brick arches, is supported by plate girders resting on buttresses in the foundation walls, and intermediate piers. It is finished with 1½-in. flooring in the engine room and a Portland cement covering in the boiler room.

The well in the engine room is 12 ft. by 77 ft. 6 ins. on top, and 8 ft. by 75 ft. 6 ins. in the bottom, with the narrow side facing the river. It is sunk to a depth of 9 ft. below extreme low water, and connects with the river by an aqueduct 4 ft. in diameter. The 4-ft. side walls of the well are braced by three tiers of I beams, which serve also as a foundation for the pumping machinery. The bottom of the well is lined with concrete 18 ins. thick.

The aqueduct is 158.14 ft. long, out to out, with a fall of 1 ft. 7½ ins. from the well to the river, the center line of the arch at the ends being respectively 4 ft. and 5 ft. 7½ ins. below extreme low water. About 122 ft. 3 ins. of the aqueduct was built in tunnel through the blue shale and lined with two rings of brick, using concrete packing; the rest was built in open cut inside a coffer-dam on a concrete foundation and cased in stone masonry, forming a pier 12 ft. wide by 35.9 ft. long in the river channel. This pier is shown in detail. A groove in the masonry in front of the opening holds a strong iron grating which can be removed and replaced with a bulkhead, in case it should become necessary to close the aqueduct for repairs or other reasons.

The well end of the aqueduct can be closed by a 4 ft. gate, operated from the engine room floor. An 8-in. pipe, laid from the bottom of the aqueduct through the wall into the well, and communicating with the force main of the pumps, serves three purposes:

1st. As a by-pass, to assist in opening the gate;

2d. Or as a means of flushing out the mud from the aqueduct by a horizontal jet;

3d. For flushing and cleaning the strainers at the end of the suction pipes of the pumps, by inside vertical jets.

The pumping machinery consists of two Gaskill compound pumping engines, of 5,000,000 galls. capacity each, guaranteed to deliver that quantity of water in the reservoir in 24 hours, with a consumption of Pittsburg coal not to exceed 18,000 lbs. when the vertical lift from the water level in the river is 385 ft., and the steam pressure in the boiler 100 lbs. These engines occupy only a part of the space over the well, leaving room enough to spare for an additional 10,000,000-gall. engine.

For the purpose of pumping out the well for cleaning or repairs a Worthington pump of the Admiralty type, 700,000 galls. capacity in 24 hours, is suspended from the roof trusses by means of differential blocks, and works between iron guides in the well, the discharge and steam connections being made with flexible hose.

The steam is furnished by a battery of six horizontal tubular boilers, 5 ft. 6 ins. diam. and 18 ft. long, the trailing flue at the back end thereof leading to a brick stack 6 ft. internal diameter and 101 ft. high from the floor of the house.

The 30-in. force main, after crossing the railroad track at the foot of the bluff, ascends the hill with a continuous rise and crosses the dividing ridge between the Licking and the Ohio in a tunnel 295.5 ft long, 38 ft. below the surface, the highest point of the pipe being at the west end of the tunnel, 3,164 ft. from the engines (horizontal measurement), and 378.1 ft. above low water from the pumping station. On the steep side hill near the river the force main is laid on wedge-shaped concrete blocks, put in every 100 ft., to firmly secure the pipe in position.

Provision is also made for a direct discharge into the lower basin as a preventive against a possible interruption in the service of the upper basins. The section of the tunnel given, shows the open standpipe at the apex of the pipe line in the tunnel shaft, acting as a safeguard in case all the stop valves at the outlets should be accidentally closed when the pumps are started.

The three basins of the reservoir (see inset of May 10) are formed by damming a ravine below its fork and damming each branch above the fork. The surface material is a yellow clay of irregular character, varying from tough to sandy, with occasional strata of limestone, overlaying the hard blue shale to depths varying from 2 ft. to 12 ft. The excavations of the basins were laid out to conform, as nearly as practicable, with the natural contours of the ground, using the materials excavated, after proper selection, for the construction of the dams.

The side slopes have a uniform rate of inclination of 3 horizontal to 1 vertical. The bottoms have an inclination of about 4 ft. in 100 ft. toward the dams, this being the average rate of fall of the ravine.

A level berme road, 12 ft. wide, surrounds each basin, connecting on a level with the top of the dams. A ramp of 8 ft. in 100 ft. on each side of the lower basin connects the berme of that basin with those of the two settling basins, 25 ft. above. On the outside of this berme road a paved ditch collects the surface water and delivers it below the lower dam. The direction of the arrows on the plan marks the division and the direction of the drainage. The force main is laid outside the berme of the two settling basins, following closely the contours of the same.

The present inset shows the construction of one of the inlets to the settling basins, built with grooves in the side walls for connection with a weir (not shown) through which the delivery is to be measured when the duty test of the pump is made. The bottom of each basin is revetted with concrete, 15 ins. thick, extending on the sides to a plane 35 ft. below the berme for the settling basins, 15 ft. below the berme for the lower basin. This concrete is divided into irregular squares of about 500 sq. ft. area, by lines of paving blocks, to avoid the cracks by contraction, which generally occur in large, continuous areas. The concrete is finished to a smooth surface, with a covering of Portland cement mortar, mixed in the proportion of two measures of sand for one of cement.

The side slopes above the concrete are revetted with paving blocks of sandstone one foot thick, laid in cement on a frost covering of broken stone one foot thick, mixed with sand and screenings. The last course of blocks projecting 4 ins. above the slope line, forms a curb for the berme road, and serves also as a base for the iron railing which incloses each basin; this curb is laid on a foundation of concrete. The inset shows in cross sections the revetment and berme road.

The dams are 15 ft. wide on top, with slopes of three to one on the basin sides, and of 1¾ to 1 on the other. At the berme level of the lower basin, the intermediate dams have a horizontal offset 30 ft. wide, upon which are located the shaft houses leading to the pipe tunnels under the dams.

The dams are built of earth with a clay puddle front on the basin's side 5 ft. wide on top, and a back slope of 1¾ to 1, which gives a rate of increase in width of puddle of 1¼ ft. for every foot in depth. The entire base of dams between foot of slopes was cleared of all perishable matter and vegetable earth, the embankment resting on the stiff clay furrowed in zig zag on the hill side. The entire base of the puddle front is excavated down through the clay into the blue shale.

The puddle is made of selected clay chopped up with the spade, excluding stones measuring over 2 ins., wetted with a hose and rolled in horizontal layers 6 ins. thick, with grooved rollers of about 2 tons weight. The embankment back of the puddle is built in the same way, in 12-in. layers, using the clay and rock excavated from the basins, and excluding stones measuring over 6 ins. The finer material is placed next to the puddle, and a sufficient quantity of clay is used with the loose rock throughout the bank to give a compact mixture.

Archways for the pipes under the dams are built in excavation through the blue shale; they are 6 ft. span for the intermediate dams and 12 ft. for the lower dam. They begin at the shafts and end in the puddle front next to the basins, being closed by head walls 3 ft. and 4 ft. thick, respectively. Cross ribs of concrete are built on top of the arches, every 25 ft., in a covering of puddle 2 ft. thick. The shafts are 12 ft. in diameter for the intermediate dams, and 16 ft. in diameter for the lower dam, with walls 18 ins. thick. A round house of brick, built over each shaft, is so constructed that the valves or any other casting in the tunnel can be readily taken out by means of hoisting pulleys, suspended to a cross beam of the roof. The valves are operated from the floor of these houses, which are also used for the storing of tools.

The outlet for each basin is located at the foot of the inside slope of the dam thereof, the water being taken at any desirable depth below the surface, through a floating tube hinged to an elbow on the effluent pipe in such manner as to rotate in a vertical plane, perpendicular to the direction of the dam. The water flows into the tube through a straining head, made of 1 in. by 1 in. angles ¼ in. apart; the position of the tube is regulated by a hand crab on top of the dam, and a chain fastened to the straining head.

The effluent pipe for each of the settling basins forks out at the tunnel shafts, one branch, ending with an open elbow in the lower basin at the foot of the dam, conveys the water from the upper to the lower basin. The other running across and under the bottom of the lower basin, can take the water directly to the city main in the tunnel under the lower dam, when, from any cause, the lower basin is out of service. These pipes are all laid in trenches excavated in the blue shale and filled with concrete. In the same trenches are laid two lines of 8 in. pipes draining the upper tunnels into the lower one. Another 8-in. pipe drains the lower tunnel through the back slope of the dam to the creek.

Each of the two upper basins is cleaned through the same pipe which conveys the water directly to the city main. An 18-in. branch in said pipe at the base of the vertical section from the floating tube ends with an elbow flush with the bottom of the basin; the opening being closed with a bell valve operated with a hand crane from the top of the pier. A prolongation of the pipe beyond the stop valve in the lower tunnel conveys the muddy water to the creek. The lower basin is cleaned by means of the same arrangement of bell valve and hand crane through an independent pipe 18 ins. in diameter, which joins with the prolongation of the pipe from the upper basins at the lower end of the tunnel.

The cleaning is done by flushing the mud with a water jet from an ordinary fire hose under 100 lbs. pressure. For this service, a stationary force pump, located on the berme of the lower basin, and taking water from the force main or from the lower basin when the pumping engines are not running, forces water in a line of 6-in. pipe laid in the center of the berme roads; this pipe is tapped every four or five hundred feet with 4 in. hydrant branches, which supply water to the hose. The same pump is intended to be used to supply the United States Barracks now being built on grounds adjoining the reservoir.

In excavating for the basins, several troublesome springs were encountered, which were disposed of as shown in the sketch of "spring hydrant" given. The water was led through a small vitrified clay pipe to a well hole, curbed with a section of 12 in. vitrified pipe, the top of which is flush with the top of the concrete revetment. In the center of the well stands a spring hydrant made of brass, and composed of a perforated pipe, reaching down to the bottom of the well through a stone block capping the well, and a perforated box housing a rubber ball, screwed on top of the pipe. This arrangement allows the spring water to flow out when the pressure thereof exceeds that in the reservoir, and prevents the escape of any water from the reservoir.

These works were designed and carried out under the supervision of Mr. G. BOUSCAREN, C. E., as consulting engineer. Mr. A. PETRI was the resident engineer.

Fig. 1.—Rock Fill Dam Across Pecos River, Eddy Co., N. M.

[Scour Gate shown at the right, and channel for head gates and water way at the left.]

Rock Fill Dam Across the Pecos River.

We are indebted to Mr. H. H. CLOUD, Chief Engineer of the Pecos Irrigation and Investment Co., of Colorado Springs, Col., for the accompanying views and description of the rock fill dam and other works now being constructed by that company across the Pecos River, in Eddy Co., N. M., 30 miles above the Texas State line. The entire length of the dam is 1,040 feet; its greatest height above bed rock is 45 ft.; the greatest depth of water, 40 ft. Other dimensions are: Width of dam at water level, 21.5 ft.; width of dam at extreme top, 6.5 ft.; slope of lower or down-stream side, 1 to 1; slope of upper side, laid rock, ½ to 1; faced by a 2 to 1 slope of earth facing; 33,000 cu. yds. rock embankment made by 19,000 cu. yds. of rock excavation. The rock channel in which head gates are to be placed is 500 ft. long, 30 ft. wide, and 25 ft. greatest depth.

The surface of water in the canal and reservoir is

20 ft. above standard grade. The scour gate is 4 ×8 ft.; culvert, 4×8×90 ft. The bottom of the culvert is 9 ft. below standard grade of canal, and 29 ft. below surface of water in reservoir. The spillway was to have been 280 ft. wide, but has been enlarged to 320 ft., by 5 ft. deep. The backwater of the reservoir is 6 miles; greatest width, 1¼ miles; estimated capacity, over 1,000,000,000 cu. ft.

The dam is a rock fill in which the lower or down stream side is allowed to take its natural slope (in this case 1 to 1). The upper side is a rough laid wall with a slope of ⅓ to 1, and having an earth face to the top of dam with a slope of 1½ to 1. Fig. 1 shows the connection of the dam with the supply channel. The 5 ft. water crest is yet to be placed on top of the dam.

Fig. 2.—Rock Fill Dam Across Pecos River. Showing Cutting Action of River on Earth Bottom.

[Scour Gate Outlet in Foreground.]

View No. 2 (not reproduced) showed the position of scour gate, the end of the channel pier which appears in Fig. 2; also the flume for a small canal which supplies the farms and city below, which is to be kept open during entire construction.

Fig. 2 shows the cutting action of the river on the earth bank in front of the advancing dam; also, the face of the dam on the opposite side of the river. The dam is placed upon the solid rock-bed forming the river channel.

As shown in Fig. 2, the water was made to excavate the bank from in front of the dam for an average height of 14 ft. to the solid rock, and for a distance of over 300 ft.

Another canal will be taken out from the main channel as seen in Fig. 1, which will be 10 ft. higher than the one above alluded to, in order to cover land on the east side of the river.

The Tensile Strength of Beton.

We are indebted to the *Wochenschrift des Oesterr. Ingenieur-Vereines* for the following notes regarding the tensile strength of beton. The tests were made at Ymuiden in the winter of 1888-89. Each block was 3 ft. 3.5 ins. long, and 7.9 ins. wide and deep. The blocks were allowed to stand five days in the open air, and then buried a yard deep in sand, where they remained for 120 days. The tensile tests were made by supporting the ends of the pieces, and then loading the center until fracture took place.

The ordinary formula, $M=\frac{f\ I}{y_o}$, does not hold in this case, since the tensile strength of beton is only from one-seventh to one-tenth of its compressive strength. Hence the neutral axis of such a beam does not pass through the center of gravity of the section, which is the hypothesis at the base of the above formula. We must employ the formula deduced in §248 of Weisbach's "Mechanics," Part I., viz.:

$$\text{The breaking strain} = n\ \frac{\text{breaking moment}}{b\ h^2},$$

in which b is the width and h the depth of the beam, while n is a variable quantity, depending upon the ultimate tensile and compressive strengths of the material. A mean of 672 tests gave for n the value of 2.538. This equation was the basis of the calculations of Table I. given herewith:

The Specific Gravity.—The mean specific gravity of all the blocks made with broken granite was 2.210; of blocks of broken vitrified brick (clinkers), 2.001, and of blocks with broken sandstone, 2.241. Hence, in constructing quays, breakwaters and similar structures, where weight is a desideratum, beton with sandstone is to be preferred.

If we examine farther into the elements making up the total weight of the beton, we find (see Table II.) that the larger the pieces of broken stone the greater is the weight of the mixture.

The relation between the proportions of sand and cement and the cost are shown in Table III., where the tensile strength per square inch and cost per cubic yard are given. The table was calculated on the supposition that 13 cu. yds. of dry materials would give 9 cu. yds. of beton. The prices of the materials are as follows:

Portland cement	$4.24 per 1,000 lbs.
River sand	.36 per cu. yd.
Broken vitrified brick (clinkers)	1.30 "
Broken granite	1.95 "
Broken sandstone	68 "
Labor per cubic yard of beton made	1.02 "

We see from Table III. that the cost of each cubic yard of beton is increased by $1.07 when we pass from the proportion of 1¼ parts of cement and 3¾ parts sand to 2 parts cement and 3 parts sand. At the same time an increase in tensile strength takes place, which amounts:

With broken granite to	75 lbs.	per sq. in.,	or 75 p. c.
" " clinkers	60 "	"	or 63 "
" sandstone	30 "	"	or 29 "

It follows, therefore, that each increase of 10 lbs. in strength costs,

With broken granite, $10\frac{1.07}{75} = 14$ cents.

" " clinkers, $10\frac{1.07}{60} = 18$ cents.

" " sandstone, $10\frac{1.07}{30} = 36$ cents.

if the amount of cement is increased in the above proportions.

In cases where a strong beton is desired and the cost of the same is not of great importance, granite or clinkers should be used. If a weaker beton will suffice and a low price is also necessary, Table III. shows that only with sandstone can this economy be effected without seriously weakening the mass.

When a strength of 114 lbs. per sq. in. is enough, the mixture of 1.5 volumes of sand, 3.5 volumes cement and 5 volumes sandstone is in every way the best.

Influence of the kind of stone on the strength.—The mean of a series of tests with 24 blocks of each kind of stone gives as the

Tensile strength of beton with	granite	128 lbs.	per sq. in.
" " "	clinkers	125 "	"
" " "	sandstone	119 "	"

If we use a cement of three volumes of sand and two of hydraulic cement, we have the

Tensile strength of beton with	granite	175 lbs.	per sq. in.
" " "	clinkers.	155 "	"
" " "	sandstone	134 "	"

Hence, granite, and probably every other hard stone with a rough fracture, is to be preferred in this work; sandstone seems to be the least desirable material.

Effect of the size of the broken stone.—Using granite, it is difficult to see any effect produced by variations in the size of the stones. Still it will be seen that a mixture of 1.25 volumes of cement, 3.75 volumes of sand and 5 volumes of stones of all sizes, gives the strongest beton. When clinkers are used, it will be found that the strength gradually increases as the stone used is reduced in size. When this material is used, however, it is best to have the broken fragments of the same size, since the beton is otherwise seriously weakened. The finer the sandstone fragments are the greater the strength of the resulting mixture. But, unlike clinkers, sandstone pieces of different sizes are beneficial in a beton.

In addition to the 72 blocks of table I. 6 others were used.

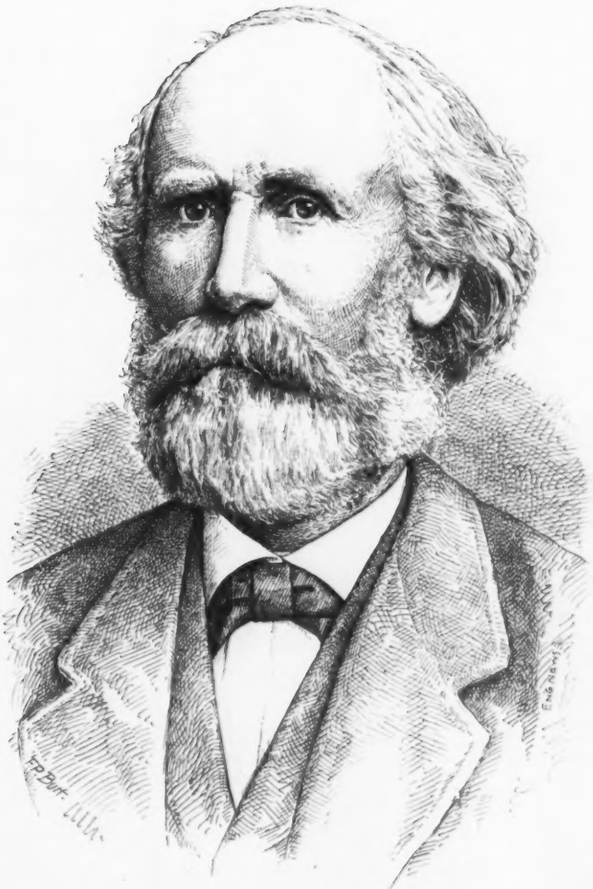
A block composed of 2 volumes cement, 3 volumes sand, 3 volumes clinkers and 2 volumes stone, which had lain 660 days in damp sand, had a specific gravity of 2.334 and a tensile strength of 114 lbs. per sq. in.

A block of 2 volumes slag cement, 3 volumes sand, 3 volumes clinkers and 2 volumes granite had, after 160 days, a specific gravity of 2.090 and a tensile strength of 88 lbs. per sq. in.

Six blocks formed by building up a beam of clink-

TABLE I.—BETON WITH BROKEN GRANITE.

No. of block.	No. of days old.	Composition in volumes. Cement.	Sand.	Stone.	Size of stone in inches.	Specific gravity. Each block.	Mean of two similar blocks.	Breaking weight in pounds.	Distance of fracture from center in inches.	Tension in pounds per sq. in. at the outside of the beam. At Point of Fracture. Each block.	Mean of two similar blocks.	At Center of beam. Each block.	Mean of two similar blocks.	Remarks.
1	121	2	3	5	1.6	2.254	2.276	4,300	.8	186	188	196	200	One-third of the stones in the fractured surface broken.
2	121	2	3	5	1.6	2.288		4,731	1.2	189		203		One-fifth of the stones in the fractured surface broken.
3	121	2	3	5	0·8	2.233	2.215	3,792	.4	159	152	163	156	Most of the stones pulled out.
4	121	2	3	5	0.8	2.206		3,406	.4	145		149		One-half the stones broken.
5	121	2	3	5	0.4	2.198	2.202	4,584	0	192	185	192	187	Three-fourths of the stones broken.
6	121	2	3	5	0.4	2.206		4,088	.4	177		181		Nearly all " "
7	121	1⅛	3½	5	1.6	2.246	2.228	3,512	1.6	138	128	151	142	One-half " "
8	121	1⅛	3½	5	1.6	2.210		3,046	1.6	121		132		Three-fourths " "
9	120	1⅛	3¼	5	0.8	2.223	2.237	2,236	2·8	85	76	101	85	One-fourth " "
10	120	1⅛	3¼	5	0.8	2.250		1,580	.8	67		68		One half " "
11	120	1¼	3½	5	0.4	2.155	2.174	2,370	.4	98	101	100	103	Three-fourths " "
12	120	1¼	3½	5	0.4	2.192		2,412	.4	104		105		Three-fourths " "
13	120	1¼	3¾	5	1.6	2.209	2.202	2,273	1.2	94	94	100	97	One-fourth " "
14	120	1¼	3¾	5	1.6	2.194		2,116	0	94		94		One-half " "
15	120	1¼	3¾	5	0.8	2 148	2.158	2 317	.8	97	96	101	101	Three-fourths " "
16	120	1¼	3¾	5	0.8	2.167		2 251	.8	94		98		One-fifth " "
17	120	1¼	3¾	5	0.4	2.152	2.152	2,212	1.2	90	93	97	97	Three-fourths " "
18	120	1¼	3¾	5	0 4	2,151		2,225	.4	95		97		One-fourth " "
19	118	2	3	5	.4-1.6	2.363	2.250	4,022	0	180	176	180	181	All " "
20	118	2	3	5	.4-1.6	2 255		4,235	.8	172		181		" " "
21	118	1⅛	3½	5	.4-1.6	2.185	2.189	3,107	.8	129	129	135	134	One-fourth of the small stones broken and all pulled from the cement.
22	118	1⅛	3¼	5	.4-1.6	2.192		3,055	.4	129		132		" " " " " "
23	115	1¼	3¾	5	.4-1.6	2.218	2.224	2,920	.4	125	119	128	123	" " " " " "
24	115	1¼	3¾	5	.4-1.6	2.229		2,679	.8	112		117		" " " " " "



MOSES LANE.

TABLE I.—BETON WITH BROKEN VITRIFIED BRICK (CLINKERS).

Number of the block	Number of days old.	Composition in volumes. Cement.	Sand.	Stone.	Size of stone in inches.	Specific gravity. Each block.	Mean of two similar blocks.	Breaking weight in pounds.	Distance of fracture from center in inches.	Tension in pounds per sq. in. at the outside of the beam. At point of fracture. Each block.	Mean of two similar blocks.	At center of beam. Each block.	Mean of two similar blocks.	REMARKS.
25	125	2	3	5	1.6	1.987	2.007	3,254	2	127	152	142	160	Fracture porous, nearly all of the stones broken.
26	125	2	3	5	1.6	2.026		4,025	0	178		178		" " " "
27	125	2	3	5	0.8	2.024	2.040	3,785	0	168	162	168	167	" " " "
28	125	2	3	5	0.8	2.055		3,759	0.8	155		165		" " " "
29	124	2	3	5	0.4	2 012	2.000	4,066	0	177	183	177	183	Fracture porous, the majority of stones broken.
30	124	2	3	5	0.4	1.989		4,295	0	188		188		" " " "
31	119	1½	3½	5	1.6	2.000	1.906	2,447	0	108	109	108	109	Fracture porous, one-half of stones broken.
32	119	1½	3½	5	1.6	1.992		2,779	0	110		110		Fracture porous, the majority of stones broken.
33	119	1½	3½	5	0.8	2.014	2.020	2,995	0	132	144	132	144	" " " "
34	120	1½	3½	5	0.8	2.026		3,678	0	156		156		" " " "
35	120	1½	3½	5	0.4	2.015	1.987	3,153	3.2	119	130	145	143	" " " "
36	120	1½	3½	5	0.4	1.959		3,277	0	141		141		" " " "
37	119	1¼	3¾	5	1.6	1.950	1.961	2,794	3.9	95	98	122	111	One-half of the stones pulled from cement.
38	119	1¼	3¾	5	1.6	1.972		2,381	0.8	100		104		Majority " " " "
39	119	1¼	3¾	5	0.8	1.983	2.014	2,451	0	105	120	105	121	" " " "
40	119	1¼	3¾	5	0.8	2.044		3,197	0.4	135		138		" " " "
41	121	1¼	3¾	5	0.4	1.977	1.985	†	...	..	..	—	...	Three-fourths of stones broken, untrustworthy.
42	121	1¼	3¾	5	0.4	1.992		†	...	..	..	—	...	" " " "
43	118	2	3	5	.4-1.6	1.998	2 008	3,019	1.6	122	127	134	134	Two-thirds of stone broken.
44	118	2	3	5	.4-1.6	2 017		3,288	1.2	132		142		" " " "
45	118	1½	3½	5	.4-1.6	2.022	2.00a	1,995	7.1	54	82	90	102	
46	118	1½	3½	5	.4-1.6	1.986		2,584	0.8	110		114		
47	118	1¼	3¾	5	.4-1.6	1.991	1.994	2 035	5.5	64	71	92	88	
48	118	1¼	3¾	5	.4-1.6	1.997		1,876	1.6	77		84		

TABLE I.—BETON WITH SANDSTONE.

Number of the block.	Number of days old.	Composition in volumes. Cement.	Sand.	Stone.	Size of stones in inches.	Specific gravity. Each block.	Mean of two similar blocks.	Breaking weight in pounds.	Distance of fracture from center in inches.	Tension in pounds per sq. in. at the outside of the beam. At point of fracture. Each block.	Mean of two similar blocks.	At center of beam. Each block.	Mean of two similar blocks.	REMARKS.
49	121	2	3	5	1.6	2.236	2.272	3,008	1.6	119	128	132	135	Few of the stones broken; the greater part pulled from the cement.
50	121	2	3	5	1.6	2.307		3,116	0	137		137		
51	121	2	3	5	0.8	2.213	2.214	3,131	0.8	129	124	135	132	
52	121	2	3	5	0.8	2.214		2,946	1.2	119		128		
53	120	2	3	5	0.4	2 230	2.257	3,827	0	166	156	166	159	
54	120	2	3	5	0.4	2.285		3,505	0.8	145		152		
55	120	1½	3½	5	1.6	2.254	2.254	2,048	1.6	84	83	92	94	
56	120	1½	3½	5	1.6	2.254		2,130	2.8	81		95		
57	120	1½	3½	5	0.8	2.238	2.244	2,719	0.4	117	109	118	113	
58	120	1½	3½	5	0.8	2 249		2,397	1 2	101		108		
59	122	1½	3½	5	0.4	2.176	2.184	2,202	0.8	98	102	102	111	
60	122	1½	3½	5	0.4	2.191		2,699	2.0	105		119		
61	122	1¼	3¾	5	1.6	2.219	2.225	1,854	0	82	90	82	90	
62	122	1¼	3¾	5	1.6	2.230		2,216	0	97		97		
63	122	1¼	3¾	5	0.8	2.205	2.227	2,242	0.4	98	93	100	94	
64	122	1¼	3¾	5	0.8	2.249		1,967	0	88		88		
65	122	1¼	3¾	5	0.4	2.219	2.232	†	0		94		100	Untrustworthy.
66	119	1¼	3¾	5	0.4	2.245		2,242	1.2	94		100		
67	119	2	3	5	.4-1.6	2.274	2.275	3,127	2 0	122	129	137	141	The greater part of the stones pulled from the cement.
68	119	2	3	5	4-1.6	2.275		3,164	1.2	135		145		
69	120	1½	3½	5	.4-1.6	2.287	2.264	4,209	0.4	182	175	188	178	
70	120	1½	3½	5	.4-1.6	2.241		3,794	0	167		167		
71	120	1¼	3¾	5	.4-1.6	2.239	2.245	3,367	0	145	139	145	139	
72	120	1¼	3¾	5	.4-1.6	2.251		3,072	0	132		132		

TABLE II.

Size of stones in inches.	Specific gravity of Beton. Granite.	Average of the blocks numbered.	Clinkers.	Average of the blocks numbered.	Sandstone.	Average of the blocks numbered.
1.6	2.235	1, 2, 7, 8, 13, 14	1.988	25, 26, 31, 32, 37, 38	2.250	49, 50, 55, 56, 61, 62
0.8	2.203	3, 4, 9, 10, 15, 16	2.025	27, 28, 33, 34, 39, 40	2.228	51, 52, 57, 58, 63, 64
0.4	2.176	5, 6, 11, 12, 17, 18	1.991	29, 30, 35, 36, 41 42	2.224	53, 54, 59, 60, 65, 66
0.4 to 1.6	2.224	19-24	2.002	43-48	2.261	67-72

TABLE III.

Proportions (volumes.) Cement.	Sand.	Stone.	Cost in dollars of 1 cu. yd. with Granite.	Clinkers.	Sandstone.	Tensile strength in pounds per sq. in. using Granite.	Average of the blocks numbered.	Clinkers.	Average of the blocks numbered.	Sandstone.	Average of the blocks numbered.
2	3	5	5.26	4.81	4.32	175	1-6, 19, 20	155	25-30, 43, 44	134	49-54, 67, 68
1½	3½	5	4.57	4.09	3 66	120	7-12, 21, 22	114	31-36, 45, 46	117	55-60, 69, 70
1¼	3¾	5	4.13	3.80	3.31	101	13-18, 23, 24	96	37-40, 47, 48	104	61-64, 66, 71, 72

ers, 1 brick wide and 4 high, gave the results shown in Table IV. Greater strength could not be expected since the tensile strain requisite to break a clinker would never rise much above 100 lbs. per sq. in.

TABLE IV.

No. of the block.	No. of days old.	Composition of the block. Cement.	Sand.	Specific gravity	Tensile strength in pounds per square inch.	
1	119	2	3	1.971	110	99
2	119	2	3	1.979	88	
3	119	1½	3½	1.936	88	88
4	119	1½	3½	1.936	88	
5	119	1¼	3¾	1.958	90	84
6	119	1¼	3¾	1.952	77	

When the cement used in the last six tests was composed of 2 volumes cement and 3 volumes sand, no fractures occurred in the joints between the bricks, which would seem to indicate that the cement was stronger than the clinkers. When the amount of hydraulic cement is diminished so that the proportions are 1.5 to 3.5 or 1.25 to 3.75, the different parts of the block seem to have about the same tenacity. These tests show that there is no advantage gained by using built blocks in place of beton.

A Compound Locomotive for South America.

We present this week a view and description of a compound freight engine, one of a number built for a metre gauge railway in South America. These engines were built by Sharp, Stewart & Co., Atlas Works, Glasgow, Scotland, to which firm we are indebted for the particulars given and the photograph from which our cut is made. The firm has also built a number of compound passenger engines for the same line. The engine illustrated is of interest as it is an English built engine of the consolidation type, and appears to include other American features in the extension smoke box, outside cylinders, etc. Plate frames are used in accordance with standard English practice, and the safety valves are of the Ramsbottom type, generally used in England. The tender is of thoroughly English design, having plate frames and three rigid axles. It may be inferred from the general design of this engine and of other engines built in England for South America and other countries with similar conditions in regard to railways, that English locomotive builders recognize the advantages of American types of engines and are adopting some of the features of the American locomotive on engines for English and foreign railways.

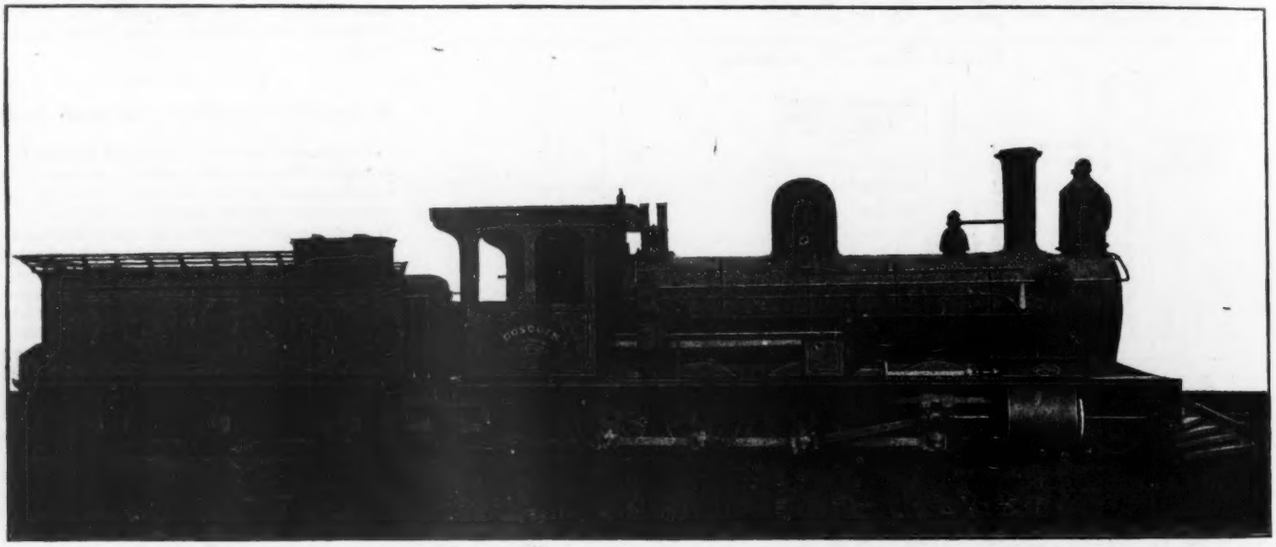
The engine is constructed on the Mallet system, i. e. with one high-pressure and one low-pressure cylinder, the high-pressure cylinder being on the left hand side. The exhaust steam from the high-pressure cylinder passes round a horseshoe pipe of large diameter, in the smoke box, forming the receiver. About two-thirds of the way round this pipe is placed the Worsdell & Von Borries automatic intercepting valve, which is seen in the cut protruding from the top of the smoke-box on the right hand side. In this valve, a horizontal plunger with a large flat circular valve cast on the end, allows the free passage of exhaust steam from the high-pressure to the low pressure cylinder when the engine is running, the valve being kept open by the pressure of steam in the receiver. When the regulator is first opened on starting the engine, steam is admitted from the main high-pressure steam pipe through a small branch pipe to two small pistons or plungers, which act on the back of the main valve, closing it toward the high-pressure cylinder, and at the same time admit a small quantity of live steam through a suitable passage into the low-pressure steam chest, the seating of the main valve preventing this live steam from blowing back into the high-pressure steam chest. As soon as the piston of the high-pressure cylinder has made a stroke, the exhaust steam passes through the receiver and opens the main valve by reason of its superior area, and at the same time closes the live steam passage to the low-pressure cylinder. The engine thus starts automati-

cally with the cranks in any position, by the simple opening of the regulator or throttle.

The following are the leading dimensions, etc.

Gauge of line	1 metre.
Cylinders, H. P.	16 ins. diam. x 24 ins. stroke.
" L. P.	23 ins. diam. x 24 ins. stroke.
Driving wheels, 8 coupled, diam. on tread	3 ft. 6 ins.
Truck wheels, diam. on tread	2 ft. 3 ins.
Wheel base, rigid	12 ft. 7 ins.
" " total	19 ft. 2 ins.
All wheel centers of cast steel	
Axle-boxes of cast steel	
Boiler, working pressure	175 lbs.
" smallest diameter inside	3 ft. 11 ins.
" length between tube-plates	10 ft. 5⅛ ins.
Fire-box, length inside	7 ft. 0 ⅝ ins.
" width inside at bottom	2 ft. 1⅛ ins.
" depth inside	4 ft. 0¼ ins.
Tubes, No. 154; pitch, 2 19-32 ins.; external diameter	2 ins.
Heating surface, fire-box	92.25 sq. ft.
" " tubes	845.50 "
Heating surface, total	937.75 sq. ft.
Grate area	15 sq. ft.

The boiler barrel, smoke-box tube plate and fire-box shell are of "Best Yorkshire" iron, made by the Lowmoor Iron Co. The inside fire-box is of best copper plates, and the tubes are of solid drawn brass. The low-pressure piston is of forged steel; the rod is prolonged forward and guided through the front cover. For the boiler feed there are two No. 8 Gresham restarting injectors. The low-pressure slide valve is of the Allan (or Trick) double admission



Compound Freight Locomotive (Metre Gauge) for South America. Built by SHARP, STEWART & Co., Glasgow, Scotland.

pattern. The wheel centers and axles boxes are all of cast-steel.

The engine is strongly built, lightness being obtained as far as possible by the use of flanged stretcher plates, instead of plates and angle irons. The details are said to call for no special remarks. The framing is constructed in the usual English method, of steel plates, and the various working parts have been specially designed to counteract the effects of a very dusty road. The slide bars are actually cased in, the casing not being shown, however, in the illustration. The crossheads are of cast steel, made in one piece, clipping the slide bars (of which there is only one on each side), with gun metal slippers inserted.

The engines which have been put to work are reported as giving great satisfaction, running freely and pulling heavy loads, showing at the same time a considerable economy in fuel and water over other engines on the same road. No formal experiments have, however, been carried out with these engines.

The Niagara River Power Co.

The utilization of the water-power of Niagara River is again before the public, and this time with an apparent business backing. Four years ago the Niagara River Hydraulic Tunnel, Power & Sewer Co. was incorporated with $200,000 capital, with power to increase it to $3,000,000. This is the parent of the present company, which is now known as the Niagara Falls Power Co., and which a few weeks ago raised the capital stock to $2,000,000. On April 1, says the Buffalo *Express*, this company contracted with the Cataract Construction Co., of New York, for the construction of a tunnel, raceways, etc., for the sum of $3,500,000. This contract calls for the completion of the work on or before Jan. 1, 1892, and to this end about 1,300 acres of river-front have been purchased.

The late THOMAS EVERSHED, C. E., was the engineer of the original project, and though his scheme was given at the time in this journal, we repeat sufficient from his official report to explain the project, as follows:

I would respectfully submit the following suggestions for your consideration of a plan for the construction of a town plat or arrangement of lots, streets, mill races, wharves, and railroad tracks above ground on the bank of the Niagara River above Port Day, in the town of Niagara, county of Niagara, and State of New York, for the purpose of forming a town composed wholly of mills, factories and workshops, to be operated by the waters of Niagara River, by means of turbine wheels or other devices. And of a main and lateral tunnels below ground which shall serve as tail races to the said mills, factories and workshops.

The town plat to be laid out between the said Niagara River and the tracks of the New York Central and Erie R. R's.

It shall be laid out with streets running as near as may be at right angles to the course of the river and the New York Central R. R. tracks.

Every other one of these streets shall be of such a width as will allow of a raceway or conduit for the pass water from the different wheel pits and discharge the same into the main tunnel, shall be of such size, and shall be located as shall best serve the requirements of the mills above them and the general ground plan of the town plat. The bottom of these cross tunnels shall be so much above the main tunnel that they shall at all times be drained and accessible whenever the mills on that particular cross tunnel are not running.

The pits of the wheels shall be located in such a manner as to suit the particular requirements of the business to be carried on in the factory to which they belong, and shall conform to the general arrangement of the town plat. The bottom of said pits shall be at such heights above the cross tunnels that work can be done in them at the same time the rest of the mills on that cross tunnel are in operation.

If the amount of water which will pass through a tunnel 24 ft. in diameter, having a descent of one in one hundred, is used economically under heads ranging from 124 ft. to 79 ft., through turbine wheels of the latest patterns, it will give a result equal to 119,000 horse power; or, in other words, is equal to 238 factories of 500 horse power each.

I have made out below a statement of the cost of running machinery by steam and water for 1 H. P. per year as used in relatively large quantities, and as the latter power is leased in various localities in the Northern and Eastern states.

Mr. Cowles, of Rochester, gives the cost of running 1 H. P. by steam in that city at $39 per year.

Mr. Holly, of Lockport, gives, with coal at $4 per ton the cost of running 1 H. P. at $46 per year.

Messrs. Poole & Hunt, of Baltimore, give the cost to be about six-tenths of a cent per hour, with coal at $5 per ton, or $45 per year for 1 H. P. And others about the same.

For rental of steam power in Boston $175 per year per horse power is received. At Lowell the lowest is $100, with rooms. The Central Pacific Mill, with 1,000 horse-power, prefers to pay $60 per horse power for water to using steam.

The following prices are charged for water power for one horse power per year:

	Hours per day.	Dollars.
Paterson, N. J.	24	$37.50
Birmingham, Ct.	12	20.00
Mayanunk, Pa.	24	56.25
Dayton, O.	10	38.00
Wameset Dam	11¼	48.25
Lowell, Mass.	10 to 11¼	20.00
Lawrence, Mass.	10 to 11¼	20.00
Cohoes, N. Y.	10 to 11¼	20.00

I would recommend that this company charge a price so low that it will be sure to prove an inducement to manufactures to lease power.

I am of the opinion that $10 per year per horse power, to be used 24 hours per diem, will effect this, and at the same time afford the capitalists holding the stock of the company ample returns for their money invested, notwithstanding the length of time which must elapse before the whole amount of power can be rented.

This is only about one-quarter what is charged elsewhere, as shown above.

ESTIMATE OF COST.

1 main tunnel	$1,212,108
24 cross tunnels	448,430
4 shafts	38,700
12 raceways	329,927
12 bulkheads	12,200
Masonry and gates controlling sluices	27,500
Timber in cribs	45,000
Slope walls	90,000
Contingencies	46,135
	$2,250,000

The present project changes the plan of Mr. EVERSHED to the extent of tapping the river at a wide part, nearer to Port Day; and the canal is to run directly over the tunnel, with the wheel pits discharging into the cross tunnels, as proposed by Mr. EVERSHED. The present plan is to develop 20,000 horse power at first; but the ultimate tunnel capacity will be 120,000 horse power.

Among the officers of the construction company, the Buffalo *Express*, in a well-written article, mentions E. A. WICKES and F. L. STETSON, Vice-Presidents; W. B. RANKIN, Secretary; GEO. H. KENT, Treasurer. The other names mentioned in this connection include some of the strongest banking firms in New York. The engineers of the company are CLEMENS HERSCHEL, ALBERT H. PORTER and COLEMAN SELLERS.

The officers of the Niagara Falls Power Co. are as follows: President, CHARLES B. GASKILL; Treasurer, FRANCIS R. DELANO; Secretary, ALEXANDER J. PORTER; Attorneys, W. CARYL ELY, W. B. RANKIN; Resident Engineer, ALBERT H. PORTER.

The Jurapa Irrigation Canal.

We are indebted to Mr. F. C. FINKLE, C. E., of San Bernardino, Cal., for the following description of the Jurapa irrigation canal, just completed, and matter relating to it. This paper is especially interesting as containing the detail of a timber conduit designed to easily pass around sharp curves in the line:

The enterprise was undertaken by the Jurapa Land & Water Company, a stock company formed in Los Angeles in 1888. The original purchase included dry lands to the extent of 27,000 acres; that is, 25,000 acres of the Jurapa ranches and 2,000 acres of the Rubidoux ranches. These lands lay about five miles from Riverside in San Bernardino Co., and with irrigation are expected to make one of the finest orange-growing districts in the world. The company has also acquired water rights and land suitable for the development of water about seven or eight miles higher up the Santa Ana River than this tract.

In 1888 the writer was engaged by the company to devise and construct a canal system for the conveyance of water for irrigating these lands. The plan adopted was as follows: In the wet and moist bottom land and *cienegas* belonging to the company, and commencing at the lowest point, a submerged flume was laid on a grade of 5 ft. per mile. A trench was first excavated, and in it was built a flume of timbers sufficient in size to sustain the pressure of the earth above it, and varying in depth below the surface. This flume was made without a bottom, and planked on the sides with rough redwood, admitting the water through the open bottom and cracks left in the sides. The top was tightly covered with stout planking, and at intervals of about 200 ft. manholes were built as a means of access for cleaning out the flume when necessary.

After running about one mile in this manner a depth of 20 ft. below the surface was reached and an abundant supply of water was secured. This water entered the flume from a bed of coarse gravel extending pretty well along its whole length. The surface, which was formerly an immense tulie swamp, made so by springs, now became perfectly dry.

As this water supply was being developed a canal was being constructed to carry the water to the land to be irrigated. For the first half mile this canal ran along a steep, rocky mountain side; here a shelf was blasted out and a channel formed by building a masonry wall on the outer edge. The canal then crosses the Santa Ana river, on a pile trestle carrying a flume, to a further distance of one-half mile.

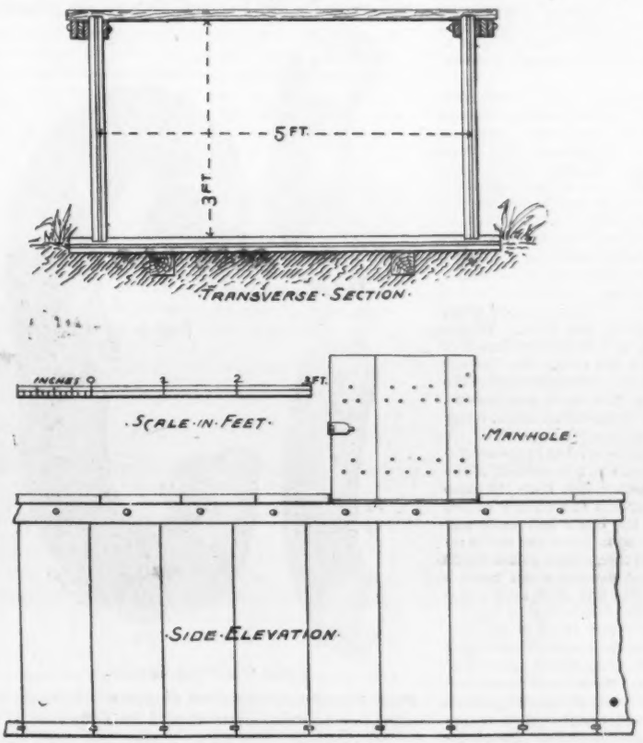
The next problem was the construction of a conduit along the slope of the steep bank on the north side of the Santa Ana River. This bank had an exceedingly steep slope, often exceeding 45°, and it was very crooked. The soil was a loose, shifting sand. The quantity of water to be carried was 3,000 miners' inches, under 4 ins. pressure. The character of the soil and the steepness of the bank forbade an open cut, and some kind of an enclosed conduit was absolutely necessary. This conduit, while devised to prevent the water from coming into contact with the soil, would also have to shut out the drifting sand from above. The quantity of water and low grade would have demanded very large pipes, and brick or concrete conduits were prohibitory in cost on this coast.

Wood was the only material available; but a conduit made of timbers placed longitudinally was made impossible by the sharp and frequent curves in the line. For these reasons, as here stated, Mr. FINKLE finally adopted the plan shown in the illustration.

The material used for the sides and bottom was surfaced and seasoned redwood plank 2 ins. thick, and cut from the butt of the trees. This redwood was very carefully selected, and according to specifications was without knots or cracks. It was furnished by the Fort Bragg Redwood Co., of Mendocino Co. As shown in the cut, this flume was built with vertical sides and top and bottom laid transversely. In the top and bottom planks grooves were cut to receive the vertical side plank, and the sides were fastened at these points by galvanized boat-spikes, and also toe-nailed at the side and bottom joint.

This aqueduct was first made up in frames, consisting of the bottom and side pieces joined, as above stated, and along the edges of the bottom and sides pieces were ⅛ × ⅜-in. grooves. The foundation for the conduit was made by laying two 4 × 4-in. stringers to grade and then tamping the earth level with the tops of the stringers. The first frame was then put in position and spiked down with the galvanized boat-spikes. Fillets, 1 × ⅛ in., were then driven into the grooves in the bottom and side plank, on both sides, and the next frame pressed up against the fillet by a lever and chain. While still held in place by the lever the bottom plank is nailed to the stringer, and the 3 × 1-in top braces are also at the same time bolted in place. These braces are made of Oregon pine, and are in three pieces, so that joints may be broken and the three 1-in. planks can be bent around the curves, while a solid 3 × 3-in. piece could not. It should be remembered that the chief advantage in the design of this conduit is the facility with which a curve can be constructed.

On a curve, the engineer computed the necessary taper in the bottom plank, and these are then sized down on one side and the usual groove cut. The side pieces are also sized and grooved to fit each end. In this way regular curves can be built as easily as if the conduits were of brick or concrete, and the angles, necessary in all timber conduits built of longitudinal plank, are avoided.



Wooden Conduit for Jurapa Irrigation Canal, near Riverside, Cal.

After it was built the inside of this conduit was coated with hot asphaltum dissolved in crude oil; this coating preserves the wood from decay and also fills up all little leaks in the joints, making the conduit absolutely water-tight. The top planks were put on last of all; they were not grooved as in the bottom plank (as wrongly shown in the cut), but were well spiked in place. This top plank can be of any cheap, rough lumber; but it must be of sufficient thickness to support all earth likely to fall upon it from the caving of banks. In this case 1½-in. lumber was used. At intervals of about 300 ft. manholes were built for cleaning and repairing the aqueduct.

These manholes were simply boxes, 2 ft. high and 2 ft wide, running across the width of the conduit. The frame was made of 4 × 4-in. lumber, and each one has a door hung on common wrought-iron hinges, and a barn-door fastening with a padlock.

Wherever the cut is not deep enough to keep the sun from the sides of the conduit, rough boards were used for this purpose, and greatly assist in preserving the material. The fall of the country was about 30 ft. per mile in the direction of the line; consequently 2½ miles of conduit landed the works on the Mesa, where three-fourths of a mile of cemented canal were built. This canal extended to the base of a low hill, and through this for 4,000 ft. a tunnel was driven. This tunnel is mainly in a quicksand, requiring heavy timbering and lagging; the cross-section intended to carry water was concreted to a depth of 5 ins., and then faced with 1 in. of cement mortar. The concrete was made of one part Portland cement to four parts sand and six parts broken stone. The facing mortar was one of Portland cement to two parts of sand. The concreting was carried on day and night, so as to avoid joints.

After emerging from the tunnel the water reaches the lands of the company, and is carried in open channels to points of distribution. Where the soil is not an impervious clay these channels are cemented. The tract of land to be watered is divided into two valleys by a range of hills, and through them a second tunnel, 2,000 ft. long, had to be driven. Unlike the first, this tunnel is through solid granite, and the wet perimeter of the channel was simply faced with 1½ ins. of cement mortar made as before described. No timbering was here required, except at the entrance. Beyond this tunnel the canal goes in an open channel as before.

The total length of the canal is 15 miles, with 8 miles of laterals, which will be increased as the land is planted. The water is apportioned by means of weirs, at the rate of one miner's inch (under 4-in. head) to each 7½ acres of land. The opening up of this orange growing tract is an important event to the city of San Bernardino, lying near it, and it is expected in a few years to literally add millions to the wealth of the city. The only other conduit like the one described, known to the writer, is that of the Citizens' Water Co., of Los Angeles.

Snow Disposal in Cologne.

The city of Cologne recently tried to dispose of a fall of snow by emptying the same into the sewers, as has been done in Frankfurt. For this purpose a number of shafts were opened into the crown of the main sewer that empties into the Rhine, each shaft being from 2 to 5 ft. square. At one of these places,

where the sewer was of an oval section, 6 ft. × 4 ft., and the fall was 1.600, it was possible to dump the snow directly from the carts, each of which held about 2 cu. yds., into the sewer without stopping the flow there. At another place, where the sewer was 4 ft. × 2.3 ft. and the same fall prevailed, this process was not possible, although a strong stream of water was thrown on the mass from the water service pipes; the large mass suddenly thrown into the sewer acted as a dam and had to be removed in other ways. But at this same shaft, when the same amount of snow was regularly thrown into it by four laborers, no stoppage occurred. A few hundred feet below the place, all the snow was found to be melted. Several hundred loads of snow were removed through these two shafts alone in a few hours.

Some Experiences with Crane Chains.*

At the Washington meeting there was some discussion on the subject of chains used for cranes, in which the opinion was expressed by the writer that the failure of such chains was almost invariably due to the use of bad material in the construction of the chain, and not to any mysterious deterioration of the iron from use. This, of course, has nothing to do with the failure of chains manifestly too light for the use. This opinion was based on a considerable personal experience with wrought iron in construction, beginning with tests of material for the St. Louis bridge.

During the past year I have had a little experience bearing directly on this subject. We have, in the foundry department of William Tod & Co., a power crane, on which we have occasionally to lift 25 tons. The crane was built about 15 years ago, and equipped with a chain made of 1⅛-in. iron, running over sheaves 16 ins. diameter. The winding drum is 20 ins. diameter, the drum and sheaves all being grooved deeply enough to prevent the links touching the bottom of the grooves. The chain had become considerably worn in the bends of the links, and had broken perhaps twice, but not at the worn places. We ordered a new chain, taking some pains to try to find reliable chain makers, and to impress on them the necessity for the best material and work. Within two weeks after putting on the new chain it broke under a load not exceeding 18 tons on the crane, the fracture being short at near the middle of the straight sides of the link. The chain manufacturers then made another one, but before it arrived the chain in use failed again, under a crane load of not more than 12 tons.

The link first broken was sent away, but in the accompanying view from a photograph, Fig. 1, is one-half of the link last broken. Fig. 2 is another link from the same chain, cut out and broken to examine the quality of the iron, and Fig. 3 is a link from the chain last made and now in use. This link was cut open hot at one end to remove it from the chain. It was then nicked on the inside of the bend at the other end, and mashed down under a hammer to its present shape. The link first broken presented a fracture similar in appearance to that of Fig. 1.

Now, here was a chain which failed twice in the first month of its use, while only two, or possibly three, links had been broken from the old chain in fifteen years' continuous use. The crystallization theory will hardly account for this, although the fractures of the broken links present the same appearance, and are just such as are usually attributed to that popular delusion. The photograph tells the whole story. The iron is cold-short and totally unfit for the use.

In characterizing the crystalization theory as a delusion I am perfectly aware that iron is often subjected to such severe flexure or vibration, continuously, as to destroy its cohesion and render it weak and brittle, but while a crane chain in constant use is treated rather rudely, it does not receive anything like sufficient punishment to produce such an effect. The fracture would also be quite different in appearance, bright, it is true, but presenting a surface of rounded granules, rather than sharp crystals.

This condition is probably caused by a gradual breaking up of the fibres, without any of the supposed rearrangement as crystals, and is doubtless very weak as well as brittle; while cold-short iron is usually very strong against a direct pull.

A phosphorus determination from borings from Fig. 1 showed .00125, or, as it is usually expressed, .125 of one per cent., which is sufficient to account for the character of the iron.

The last chain in the present case has not failed in any way up to the present time, and if it is all of as good material as the link mashed, Fig. 3, it will probably only give out when worn to an insufficient section at some point.

The question of principal interest to most of us is, how to obtain good chains. I know of but one certain way, and that involves some trouble and expense. I refer to the inspection of the material before manufacture, and of the workmanship after, by a competent engineer.

Giving a piece of chain a mild pull in a testing machine enables the manufacturer to certify that it has been "tested," and may occasionally open a particularly bad weld, but can serve no other useful purpose.

The ability to stand bending cold is the most important quality of chain material, because that is the principal, if not the only, cause of chain failure. In fact, for this purpose the cold bend test will usually show all the engineer wants to know of the material.

Perhaps, as the millennium approaches, a certificate of inspection which shall mean something will accompany all chains. At present, however, we shall have to conduct the inspection at our own expense, or take what we can get. There are, undoubtedly, some manufacturers who would make chain to suit our specifications if not hampered in price; and there may be some who make reliable work of their own free will; but the search for them is not certain to be short or inexpensive. Our own experience in this direction has not been reassuring. At any rate, we are not likely to get good chain, or good anything else, unless we ask for it. And as long as we are willing to believe that a brittle link was made so by some mysterious influence or condition of its use, so long will chains be made of cheap, cold-short iron.

The discussion of this paper served to bring out still more forcibly the fact that for all purposes

Tests of Crane Chains.

where iron is to be subjected to severe treatment a metal low in phosphorus should be called for and rigidly required. For many places cold short iron does very well, but for chains, where blows with sledges, or slips under a load, are likely to bring a percussive action to bear upon the metal, and where the metal is likely to be quenched in water when red hot, no risks should be taken with a metal which will not stand abuse. Irons low in phosphorus can be had if demanded and thoroughly inspected.

*A paper by C. SEYMOUR DUTTON, M. Am. Soc. M. E., Youngstown, O., read before the American Society of Mechanical Engineers at Cincinnati, May, 1890.

The Slipperiness of Asphalt Pavements.

In a late issue of *Le Genie Civil*, Mr. LEON MALO, the well-known expert in the use of asphalt, replies to the charges lately made by some of the English journals that this material is more slippery than any other used in the construction of street pavements. The letter of Mr. MALO is practically called out by the recent action of a London company insuring against accidents to horses. This company has been interviewing the drivers of carriages and omnibuses and has gathered together a thousand or more cases favoring the abolition of asphalt.

Mr. MALO says, that while this curious collection of "facts" has had little effect upon engineers and others familiar with roads and their construction and maintenance, the slipping of horses on asphalt pavements is a subject of such common discussion in the daily press, that something ought to be said about it, reducing the alleged disadvantage to more exact terms.

Both wood and asphalt pavements are actually slippery during fine rains or heavy fogs, if certain precautions are not taken. These precautions are, for wood, to sprinkle the streets with coarse sand; and for asphalt, to wash off the surface by streams of water from the hydrants. By these very simple expedients the slipping of horses is at once suppressed in both cases.

In Paris the sanding of pavements is not much approved of, though recognized as a good precaution. But the washing of the pavements is still less frequent, and it is rarely done at the moment when it would be of most service; that is, just when the soapy dust deposited upon the pavement in a dry season commences to be dampened by a fine rain or fog. It is just at this time that the great proportion of falls occur.

Mr. MALO cannot understand why, in Paris at least, they are more prodigal with sand than with water. The sand helps to obstruct the sewers, after having performed its office on the pavement; while the water would serve a double purpose in cleaning the streets and aiding to flush the sewers. He contends that the slipping of horses is not so much due to the street surface used as it is to the failure to keep that surface clean.

Mr. MALO believes that while individual interests may sometimes suffer from the smoothness of asphalt used as paving material, the public interests from a hygienic point of view, are of much more consequence. As he goes on to state, asphalt is not only as noiseless as wood, but it has other great advantages in cities like London and Paris over all other paving material. By its bituminous nature, and thanks to its absolute impermeability, asphalt establishes a barrier between the air we breathe and the subsoil of the streets of great cities. This subsoil is saturated with all manner of evil gases which, under varying atmospheric and hygrometric conditions, would otherwise escape. By the same qualities it prevents impure liquids, greasy water, the offal of horses, etc., from being stored up in the pavement joints or the more or less absorbent material beneath the ordinary pavement. With asphalt properly and frequently flushed with water, these and all other seeds of epidemic maladies glide over the pavement without penetrating it.

These properties of asphalt have not escaped the German engineers, nor have they been troubled by the complaints of owners of horses. They have regarded the public health as of paramount importance, and Berlin, in the last ten years, has laid more asphalt pavement than have London and Paris combined in the last 30 years.

Asphalt in Building Construction.

In a paper read before the Architectural Students' League, of Brooklyn, on May 14, Mr. T. H. BOORMAN, of the Sicilian Asphalt Paving Co., of New York, says that the first asphalt work that he knew of being laid in this country was about the year 1838, on the floors of the portico of the old Philadelphia Merchants' Exchange. Twenty-five or thirty years ago the European asphalts were also extensively imported, at great expense, by our Government for use on fortifications in covering the arches over casemates, magazines, vaults and for other similar purposes. Since 1872 they have been imported by asphalt companies and used in buildings of all descriptions.

In speaking of the item of "damp course," found in architects' specifications, Mr. BOORMAN says that it is advisable to lay throughout the walls on the grade of the cellar floor half an inch of asphalt, with a lap of about two inches on the inside, so allowing a connection with the asphalt finish of the cellar floor and hermetically sealing the house from damp, noxious gases and vermin. In residences architects will probably consider they have done their duty by asphalt if they have thus specified for a damp course and cellar floor; in the latter by the way, three-fourths of an inch of asphalt on three inches of hydraulic cement concrete will serve the desired purpose of a durable damp-proof floor. The yards of city residences are now frequently laid with asphalt, the material being peculiarly adapted to the roller-skates and tricycles of the younger members of a family. But contrasted with a building in which only one floor, the cellar, is required to be of asphalt, there are other buildings where every floor and the roof can be of this material. In printing

houses, lithographing establishments, breweries, sugar refineries and slaughter houses this material is often used throughout. This year, however, sees a novelty in construction with asphalt. THEOPHILUS P. CHANDLER, Jr., architect, of Philadelphia, is using rock asphalt on every floor of a large apartment house; the carpets will lie on the asphalt, being fastened down to narrow strips of wood set against the partitions where the asphalt is laid. In answer to the remark that asphalt is not pleasant in appearance, it might be said that the mayor's private office in the great City Building of Philadelphia, the greatest municipal edifice in the country, is laid with asphalt with a border of colored tiles.

In referring to specifications for asphalt, the speaker recommended the following as gleaned from eighteen years of experience with this material: For sidewalks and courtyards, one inch of rock asphalt on four inches of Portland cement concrete, made with the usual proportions of cement, stone and sand. For cellar floors and floors not subjected to much wear three-fourths of an inch of Limmer or other standard brand of mastic will suffice. For floors of breweries, stables, slaughter houses, sugar refineries, one inch is requisite. For ordinary hospital floors three-fourths of an inch thickness will suffice. For the roofs of fire-proof buildings on the top of concrete an inch and a quarter of rock asphalt in two coats laid on three thicknesses of felt paper, cemented with Trinidad asphalt.

The Ceredo Bridge over the Ohio River.

The accompanying sketch shows the general elevation of the bridge now under erection over the Ohio river at Ceredo, W. Va. It is being built for the Ohio extension of the Norfolk & Western R. R.; Mr. W. A. DOANE, Chief Engineer, and Mr. T. KENNARD THOMSON, Bridge Engineer.

The work on coffer dams and foundations will be done by day's labor, as soon as the present high water subsides. The contract for the substructure with these exceptions, is let to Mr. W. F. PATTERSON, of Pittsburg, Pa.

The contract for the superstructure has been let to the Edge Moor Bridge Co. As shown, there will be four spans of 298 ft., c. to c. of end pins, and one span of 518 ft.; there will be an approach of 70 deck plate-girders, of 30 ft. 7½ ins. each, on the south side of the river, and also one half-through plate-girder span of 60 ft. The trusses will have double bottom chords. The bridge is designed for a single track; but provision has been made for a center truss by making the bridge 34 ft. wide between centers of trusses. Contracts have also been let to the Pencoyd and Edge Moor works for about 45 smaller bridges each, on this Ohio extension, and about 100 more are soon to be let.

The Proposed Mississippi River Bridge Below New Orleans.

In a late pamphlet issued by the New Orleans Terminal Railway & Bridge Co., a skeleton elevation and plan is given of the bridge designed by Mr. THOMAS C. CLARKE, Consulting Engineer. This bridge would be located in the long straight reach of the river below New Orleans, and is thus opposed to the bridge of Mr. E. L. CORTHELL, which would cross the river about 12 miles above the city.

According to the sketch given the river would be crossed by one center span of 1,200 ft., and two side spans of 800 ft. each, measured from centers of piers and abutments. The extreme clearance under the bottom chord, at the center, would be 165 ft. above high-water, and under the side spans, 110 ft. As the river banks are low, a considerable length of trestle approach would be required on both sides; and to reduce the length of approaches the gradient over the bridge would be 7 per cent. To overcome this gradient Mr. CLARKE proposes to adopt the Abt system of rack-rail as being effective and as saving in approach work. The gain in tractive force of a 75-ton consolidation engine, by using the rack, would be as 382 tons is to 74 tons on this gradient. Mr. CLARKE figures that it will cost no more to draw cars over the 7 per cent. grade by the Abt system than to work a 2 per cent. grade by ordinary engines, when the saving in interest is taken into account.

As nearly as can be judged from the plan shown, the bridge would be made up of four cantilevers springing from the two center piers in a curved or arch form, and with the top-chord extending about 70 ft. above what may be called the crown of the arch, and passing from abutment to abutment clear across the river, in a regular curve. The bridge would be 30 ft. wide, and the central "suspended span" would be 500 ft. long and the end spans (from cantilever to abutment) 450 ft. each. The cantilever arms would thus be 350 ft. long each, measured from the center of the piers. The track floor would be about 80 ft. above high water at the ends, and 165 ft. at the middle of the bridge.

The two river piers would be founded on two caissons for each, sunk by dredging; each caisson 50 ft. in diameter and located 90 ft. apart on centers. These caissons would extend, probably, 200 ft. below high water and 20 ft. above high water, and be surmounted by a framed steel pier 90 ft. wide at the base and 30 ft. at the top, or 180 ft. above high-water.

Moses Lane.

(WITH PORTRAIT.)

MOSES LANE, one of the foremost American hydraulic engineers, was born in Northfield, Vt. in 1823. His father was a Green Mountain farmer, a man of keen intellect, and known throughout the State for his great size and herculean strength; his mother was descended from a cousin of BENJAMIN FRANKLIN. After attending the district school young MOSES LANE was sent to the famous military school of Captain PARTRIDGE, at Norwich, Vt., and thence to the Vermont University, from which latter institution he was graduated in 1844.

Immediately after leaving the University he commenced his profession as an engineer by taking a rodman's position on the Sullivan railway of New Hampshire Later, Governor PAINE, then President of the Vermont Central R. R., put him in charge of a corps on that road, and he there remained for three or four years. Mr. LANE found civil engineering, in 1849, a very unremunerative business, and he took charge of an academy at Springville, N. Y., where he remained until 1853.

In this year he was appointed an Assistant Engineer on the original construction of the Albany & Susquehanna Ry.; but within a year work was suspended and he again became a teacher, this time at Clarence, N. Y. Mr. LANE remained at Clarence for two or three years until he was apointed by his old chief, Mr. JAMES P. KIRKWOOD, Principal Assistant Engineer on the Nassau water-works, as the Brooklyn water-works were then called. He spent the next 15 years on this work, and in 1862 succeeded Mr. KIRKWOOD as Chief Engineer.

Mr. LANE served the citizens of Brooklyn faithfully until 1869 when his position was wanted by the politicians, with whom he was never in sympathy, and he retired. He declined to make a tour of investigation among European water-works, proposed by the authorities as a means of "letting him him down easy."

Mr. LANE's talent and experience were now public property as a consulting engineer, and he at once entered upon a most active career that ultimately resulted in his death, superinduced by overwork. While acting as consulting engineer for Indianapolis, Paterson, N. J., Baltimore, and several other cities he gave personal attention to the new system of water-works then being introduced into Pittsburg, Pa., carrying out these works with credit to himself and profit to the cities concerned.

In 1871 he accepted the position of resident engineer of the new works being built for Milwaukee, then a city of 60,000 inhabitants, and he remained there until 1878. During the last few years of his service in Milwaukee he also acted as consulting engineer for Toledo, Cincinnati, St. Louis, and several other cities.

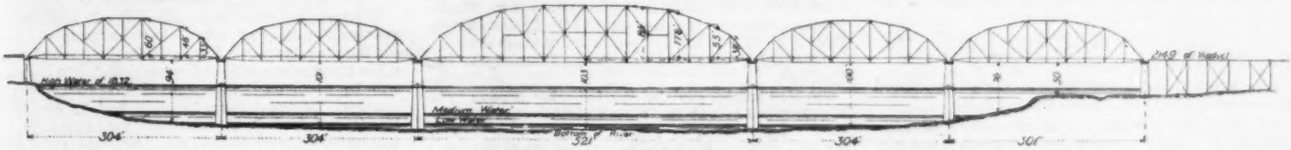
In 1875 Mr. LANE was called to Boston as a member of a commission appointed to examine into and report upon the improved sewerage of Boston. The other two members of the Commission were Mr. E. S. CHESBROUGH and CHARLES F. FOLSOM, M. D. Mr. JOSEPH P. DAVIS, then City Engineer of Boston, was formerly an assistant to Mr. LANE on the Brooklyn Water Works, and it was natural that he should seek the advice of his old chief upon a project of almost unprecedented proportions to which he, Mr. DAVIS, had devoted so much study and for which he was responsible as the projector.

In 1881, while engaged at Kansas City, Mr. LANE was called back to Milwaukee, and at the earnest solicitation of his friends there he consented to again take charge of the Department of Public Works and he continued in this position until his death, on Jan. 25, 1882.

Mr. LANE, in his personality, was a lovable man, of spotless character and noble qualities of heart and mind. He was gentle and courteous in his manner, patient with his assistants, even in their shortcomings, and possessed in a remarkable degree that peculiar quality that inspires both respect and love in those who came in contact with him, professionally or socially. He was almost childlike in his simplicity, and thoroughly unselfish; too much so for his own interests in dealing with the average man.

To the writer some have said—I loved MOSES LANE as no other man because he was my best friend. He secured me my first position as an engineer, and my second when that failed, until I was well on my feet. Another—I loved him because he was so helpful to me in my work when I served under him. Others—In my daily intercourse with him my life was made so much better and sweeter. So, whatever the line of reasoning, he certainly possessed the peculiar quality of inspiring the love of his associates, and even those who were less intimately connected with him, to so great an extent that his life was thus made memorable. Christianity seemed to him inborn. Gentleness and simplicity of character not a part, but all of himself.

It is a characteristic of great scholars and thinkers that their lives, habits and dress are simple to an extreme. This was to a marked degree true of Mr. LANE. He read the New Testament in the Greek, and mastered Hebrew, that he might study the Bible. French and German engineering books needed no translation for him. His recreation was with Virgil and Horace, and he was a mathematician of the highest order.



The Ceredo Bridge over the Ohio River at Ceredo, W. Va.

Irrigation in Congress.

Two reports are before the Senate from its Committee on the Irrigation and Reclamation of Arid Lands. One sets forth that the total area of the United States, exclusive of Alaska, is a little more than 3,000,000 sq. miles, and that over one-third of it must have artificial irrigation to insure regular annual crops. The report therefore recommends a general system of storage reservoirs for the arid lands, and a careful designation of certain lands now arid as irrigable, with provisions for their sale as homesteads.

The other report handed in by the minority, agrees in the necessity of completing the irrigation survey now in progress, and the designation of irrigable lands, but lays stress on preventing the aggregation of the water supply of the arid regions in the

hands of cattle syndicates, great individual land owners, and mining and other corporations to the detriment of small farmers. It declares that the majority bill is drawn in the interest of the great cattle and irrigating companies, instead of the homestead farmer.

The general policy of taking possession of valleys and gorges through which streams pass as reservoir sites where the surplus flow during freshets can be stored and afterward distributed during draughts, has already been sanctioned by Congress. Large appropriations have been made for the survey and segregation of such sites. The act of Oct. 2, 1888, appropriated $100,000 for this purpose; the act of March 2, 1889, gave $250,000 more; the appropriation for the next fiscal year has not yet been made, but is likely to equal or exceed $250,000. Since it was only on the 30th of March, 1888, that Congress called on the Interior Department to investigate the subject, its action has certainly been prompt and liberal. Under this legislation sites have already been reserved in the States of California, Colorado and Montana and in the Territories of Idaho, Utah and New Mexico.

The Surveyor-General for Idaho has since reported that 6,000,000 acres can be reclaimed in that Territory and made to produce from $30 to $50 worth per acre of hay, grain, and vegetables, whereas without storage reservoirs and canals Idaho's farming possibilities have already nearly been reached. The Surveyor-General for Nevada says that impounding water has as yet been little practised there, although in some cases it has been brought many miles from dams in mountain gorges with the effect of yielding crops to the value of $40 per acre on land where before only sagebrush grew.

PERSONALS.

Mr. WM. R. BAKER, formerly President of the Houston & Texas Central R. R., died May 1.

Mr. WILLIAM GIFFORD has been reappointed City Engineer and Surveyor of Schenectady, N. Y.

Mr. FRANK A. LAWTON has been appointed Superintendent of the Kennebec Central R. R.

Mr. FREDERICK HASKELL, of Chicago, died May 6. He was for many years President of the Haskell & Barker Car Co., of Michigan City, Ind.

MR. F. W. DALRYMPLE has resigned his position as Roadmaster of the Bradford division of the New York, Lake Erie & Western R.R., to accept the position of City Engineer, of Bradford, Pa.

M. DE LESSEPS has been made Honorary President of the Paris Geographical Society, an office created because M. DE LESSEPS has declined to longer serve as president owing to his advanced age.

Mr. J. HERBERT SHEDD, late of Worcester, Mass., has accepted the appointment of City Engineer of Providence, R. I., at the hands of Commissioner of Public Works, JOHN A. COLEMAN. The salary is to be $5,000 a year.

Mr. J. C. RAWN has been appointed Manager of the Roanoke Water & Gas Co., of Roanoke, Va. He will continue to discharge the duties of engineer in charge of the Clinch Valley extension of the Norfolk & Western R. R.

Mr. R. TAYLOR GLEAVES, Chief Engineer of the Pennsylvania Construction Co., of Philadelphia, Pa., has been elected a Director of the Lynchburg Belt Ry. Co., of Lynchburg, Pa. He retains the position of Chief Engineer of the Pennsylvania Construction Co.

Col. RICHARD HINTON has been appointed superintendent of the artesian irrigation system for the Department of Agriculture, and has an appropriation of $2,000 to expend before July 1, in ascertaining whether the agriculture of Dakota and adjacent States can be benefited by the artesian system.

Mr. E. SHERMAN GOULD, Consulting Engineer of the Vento Water-Works for Messrs. Runkle, Smith & Co., of 15 Wall St., N. Y., contractors for the same, has returned from Havana, Cuba. Work has rapidly progressed, and the construction of the large covered reservoir is to be commenced early next fall.

Mr. CHARLES HERMANY, Chief Engineer and Superintendent of the Louisville (Ky.) water-works; Mr. J. J. DE KINDER, consulting engineer, of Philadelphia, formerly Superintendent of Water-Works at that city; Mr. GEORGE HORNUNG, of Newport, Ky., Mr. J. N. ROBINSON, of Cincinnati, O., and Mr. THOMAS W. BOUGHEN, of Cincinnati, have been appointed expert engineers to investigate and report upon the present condition of the water-works at Cincinnati, O., and to recommend measures for their improvement. They were appointed by the Board of Public Improvements.

Mr. JAMES NASMYTH, the celebrated mechanical engineer, and inventor of the steam hammer, died May 7. He was born in Edinburgh, Scotland, Aug. 19, 1808. He was educated at Edinburgh University, and early acquired a taste for mechanics. In 1829 he went to London and became an assistant to HENRY MAUDSLAY, the well-known mechanical engineer, of the firm of Maudslay & Field. Mr. MAUDSLAY died in 1831, and NASMYTH took a temporary shop in Edinburgh, where he constructed a rotary steam engine. In 1834 he established himself in business in Manchester, and later he established larger works at Patricroft, near Manchester. Here, in 1839, he matured his great invention, the steam hammer. Among his many inventions are a mode of transmitting motion by means of a flexible shaft (1829), the torpedo ram (1839), and the hydraulic mattress press (1839). In 1857 he retired from active business and devoted himself to astronomy. In conjunction with Mr. J. CARPENTER he published "The Moon Considered as a Planet, a World and a Satellite" (1874), and in 1883 he published his autobiography.

PUBLICATIONS RECEIVED.

Reflections on the Motive Power of Heat and on Machines Fitted to Develop that Power. From the original French of N. L. SADI CARNOT. Edited by R. H. THURSTON. New York: John Wiley & Sons. 12mo. Pp. 260. $2.00.

The editor and publisher have made a real and great contribution to English scientific literature in rescuing these remarkable records, which the preface justly describes as "a relic, a memorial, a cornerstone" of modern science. Every one interested in thermo-dynamics should by all means read and study it. We shall review it more fully later.

—*A Text-Book on Roofs and Bridges.* Part I: Stresses in Simple Trusses. By MANSFIELD MERRIMAN, Prof. C. E., Lehigh University, New York. John Wiley & Sons. Second Edition; 8vo., interleaved, pp. 124. $2.50.

—*State Carriers Engaged in Interstate Commerce.*—Only the commerce which begins and ends within the same State is exempt from the Interstate law. The Interstate Commerce law does not give the Commission authority to establish through routes and through rates.

—*Journal of the Franklin Institute*, Philadelphia, Pa., May, 1890.

The May number contains the following papers: "The Metallurgical Arts at the Paris Exhibition," F. L. Garrison; "Water Ram in Pipes," I. P. Church; "Our Schools, with particular reference to Trade Schools," Joseph M. Wilson; "The Electrical Exhibits at the Paris Exhibition," Carl Hering. Reports on "The Thorne Type-Setting Machine" and "Colt's New Navy Revolver, with a new cartridge pack for reloading."

—*Fifty-first Annual Report of the Board of Public Works to the Governor of the State of Ohio, for the Fiscal Year ending Nov. 15, 1889.* Pamphlet, 160 pp. SAML. BACHTELL, Chief Engineer of Public Works.

Aside from the details of repairs and expenditures, there is considerable matter in this report of interest to those who are watching the present policy of our States regarding their canals. Condensed statistics describe the four canals under the supervision of the board, with the annual expenditures and receipts for each from its opening until Nov. 15, 1889. The Ohio canal was opened in 1827, the Miami & Erie in 1829, the Walhonding in 1844, and the Hocking in 1845. The total expenditures on all the canals has been $9,543,354, the gross receipts $15,550,689, leaving the net earnings $6,007,336. It should be borne in mind that interest payments are not included in the expenditures. Mention is made of the Lewiston reservoir, in Logan Co., covering 7,200 acres, and acting as a feeder of the Miami & Erie canal, also of the "grand reservoir" in Auglaize and Mercer counties, covering an area of 17,000 acres, and feeding the same canal.

—*Thirteenth Annual Report of the Board of Health of the State of New Jersey, and Report of the Bureau of Vital Statistics*, 1889. Pamphlet, 486 pp., contents and index. E. M. HUNT, Secretary State Board of Health.

Among the papers printed in the report may be mentioned: "The East Orange Sewage Disposal Works as Compared with other Methods," by C. P. BASSETT, M. E., Newark, N. J.; "Sewer Systems of the State," by A. CLARK HUNT, M. D., Sanitary Inspector; "Disposal of Town Refuse, Garbage Destructors," by EZRA M. HUNT, M. D.; "The Improvement of the Sanitary Conditions in the Health and Pleasure Resorts of New Jersey," by HENRY MITCHELL, M. D., Asbury Park, N. J.

—*Statistical Abstract of the United States*, 1889. 12th number. Prepared by the Bureau of Statistics. Pub. Doc., 8vo., pp. 312.

This valuable publication we reviewed so fully last year that we will not attempt it this year. A few notes are these: Interest on the national debt is only 52 cts. per head now, against $3.84 in 1857. The official estimate of population for July 1, 1889, is 64,554,000, indicating a census population for 1890 of about 66,500,000. The national debt for the first time falls below a thousand millions ($975,939,750), which is slightly less than the aggregate of State and local debts. The production of both gold and silver seems to be steadily increasing, and was last year $92,374,200, $33,167,500 of which was gold. The silver product is the largest ever recorded, except in one bonanza year, 1878; the gold rarely exceeded since the war. The mining interests have in four years increased in this marvellous way:

	Millions of dollars value—				
	1884.	1885.	1886.	1887.	1888.
Metallic products	180.4	181.6	215.4	250.5	256.3
Non-metallic products	413.9	428.7	465.3	542.3	591.7
Total.	600.3	610.3	680.7	792.8	848.0

The consumption of coffee per head has increased from 5 to 6 lbs., two decades ago, to 8.7 lbs. in 1889; tea remains nearly stationary at 1.22 lbs.

The wheat crop has not increased much in ten years and a continually less percentage is exported—21.35 per cent. in 1888 against 35.4 per cent. in 1878. The corn crop increases steadily, however, and is now 2,000 million bushels against 1,388 in 1878 and 874 in 1869. The crude petroleum product also steadily increases. At intervals of four to five years it has been as follows in millions of gallons:

1871.	1875.	1880.	1885.	1889.
149.9	222.0	424.0	574.7	616.2

The total merchant marine tonnage, which was 5,353,868 in 1860, and 4,144,641 in 1870, is now 4,307,475, which means practically a great retrograde, since other nations have increased their marines enormously in this period.

The post-office record is a remarkable one of rapid growth, and so we might go on and quote many other interesting and gratifying details, but as next year is census year it will be as well to forego further abstract.

SOCIETY PROCEEDINGS.

Northwestern Railroad Club.—At the meeting of the club at St. Paul, Minn., May 10, the subject for discussion was "Driver Brakes." The general opinion appeared to be that such brakes should be fitted, but should be used in emergency only and not in regular stops. The discussion was lengthy and interesting, but did not include sufficient records in detail for us to give it in full.

Western Railway Club.—The club will hold its next meeting May 20, at 2 P. M., in its new rooms in the Rookery Building, Chicago. The subjects for discussion are: "The Counterbalancing of Locomotives." The discussion will be based on the proposition advanced at the last meeting. "Journal Boxes," to be opened by Mr. W. H. Harrison, B. & O. R. R. The following topics have been announced for brief discussion: "Relative cost of Maintaining Rigid Center and Swing Center Bearing Trucks of Freight Cars;" "What has been Observed as to Comparative Flange Wear of Wheels."

WALTER D. CROSMAN, Secretary.

Engineers' Club of Cincinnati.—At the regular April meeting of the club, Prof. T. H. NORTON, of the University of Cincinnati, delivered a lecture on "Aluminum," the metal which is at present receiving so much attention from metallurgists and engineers, and which is said to be destined to be the metal of the future, on account of its adaptability for use for a multitude of purposes where iron and steel are now employed. The main drawback to its general use at present is the expense attendant upon obtaining it in a commercial form. This, however, by reason of various experiments and the improvements made in the manner of manipulation, is being rapidly overcome.

Engineers' Club of Kansas City, Mo.—At the meeting on April 14, President Breithaupt in the chair, Col. S. N. Stewart gave a talk on "Drawbridges as Closed by Water Power" and "Water Motors as Used in Europe." Three methods of closing floating draws by the current were described. In the first the current acts on large planks called "fins." In the second a car is pulled up an inclined railway by a cable, the draw is unlatched and swung open by the current. Fins trailing with the stream when not in use are drawn by a windlass across the stream as the draw is unlatched. The current acting on these and the draw itself, pulls the car to the top of incline. When fins are relaxed car descends incline and closes draw. In the third a boat with submerged vanes lies below bridge. A cable from its bow crosses bridge and passes around a pulley on buoy above, returning to draw. When draw is closed vanes are extended. On relaxing vanes, draw swings open by pressure of current pulling boat up stream. In none of these methods is cable left across draw opening. In the first, speed of closing is limited to velocity of current; the other two can close draw at a speed of 10 miles per hour, or more, in a two-mile current, if fins are sufficiently large. Examples of river motors were shown. In a river like the Missouri a motor would yield ten times the power of wind mill of same cost and forty times the power of a sun motor. Easily protected from drift they work in frozen rivers, but with diminished power. The writer thinks the time will come when thousands will be used in such rivers as

the Missouri, and will produce results which, if stated now, would seem too fanciful for belief.

KENNETH ALLEN, *Secretary.*

American Society of Mechanical Engineers.—The regular meeting was held this week at Cincinnati, O., opening with a session at 8 P. M Tuesday evening. The paper read by Mr. C. S. Dutton at that session, and the substance of the report of the committee on a "Standard Method of Conducting Duty Trials of Pumping Engines and Uniform Methods of Test," are given elsewhere in this issue. A full report of the convention will be given next week. The following is a partial list of the members present:

Albright, Louis, Philadelphia — Almond, Thos. R., Brooklyn—Ashworth, D., Pittsburg.

Barnaby, Chas. W., St. Louis—Barnard, Geo. A., New York — Barrus, Geo. and wife, Boston—Beck, M. A., E. Saginaw, Mich—Brisse, Henry, New York—Bond, Geo. M., Hartford, Ct.—Borden, Thos. J., Fall River, Mass.—Brown, Alex. T., Syracuse—Burgdorff, T. F., U. S. N., Knoxville, Tenn.

Cooper, Henry R., Syracuse.

Dashiell, Benj. J. Jr., Baltimore, Md.—Derbyshire, Wm. H., Philadelphia—Dick, John, Meadville, Pa.—Dock, Herman, Philadelphia—Doran, W. S., New York—Downes, G. B., New York—Durfee, W. F., Birdsboro', Pa.

Gale, Horace B., St. Louis—Gould, W. V., Norwich, Conn.—Gray, G. A., Cincinnati, O.

Haskins, Harry S., Philadelphia.—Henning, Gus. C., New York.—Hibbard, H. D., Pittsburg.—Hill, William, Collingville, Conn.—Holmes, Isaac V., Beloit, Wis.—Hunt, C. W., New York.

Jacobus, D. S. Hoboken, N. J.—Jones, W. C., Cincinnati, —Jones, W. H., Cincinnati.

Kempsmith, F., Milwaukee.—Kirk, Wm. A. L., Chattanooga.

Laird, Jno. A., St. Louis.—Lane, H. M., Cincinnati.—Lamphear, D. A. Cincinnati.—Life, C. E., Syracuse.

March, P. G., Cincinnati.—Marx, Henry, Cincinnati.—Miller, Fred. J., New York.—Morris, Henry G., Philadelphia.

Parks, E. H., Providence.—Penney, Edgar, Waynesboro, Pa.—Percival, G. S., New York City.—Porterfield, H. A., Pittsburg.—Possel, Geo. W., Cincinnati.

Robb, D. W., Amherst, N. S.—Rogers, W. S, Troy, N.Y.

Sancton, E. K., Scranton—See, J. W., Hamilton, O.—Smith, Chas. P., Norwich, Conn.—Smith, C. M. W., Dunkirk, N. Y.—Smith, Geo. H., Providence—Smith, Jesse M., Detroit—Spangler, H. W., U. S. N., Philadelphia—Spaulding, H. C., Boston—Spies, Albert, New York—Stanwood, J. B., Cincinnati—Stiles, N. C., Middletown, Conn.—Stillman, F. H., New York—Suplee, Henry H, Philadelphia.

Thomson, Jno., New York.—Tompkins, S., Knoxville.

Underwood, F. H., Conn.

Vair, Geo. O., Milwaukee.

Wall, Edward B., Columbus.—Warrington, Jesse, Indianapolis.—Webb, J. Burkitt, Hoboken.—Webster, J. H., Boston.—Weggern, Chas. O., Massillon, O.—Weston, Jno. W., Chicago.—Whitlock, R. H., College Station, Tex.—Wiley, Wm. H., New York.—Wood, Walter, Philadelphia. — Woodbury, C. J. H., Boston. — Vaile, J. H., Dayton, O.—Tilden, Jas. A., Boston.—Springer Jos. H., Hamilton, O.—Powel, S. W., Hamilton, O.—Lowber, J. G., Detroit.—Bauer, Chas. A., Springfield, O.—J. J. De Kinder, Philadelphia.—A. H Raynal, Richmond, Va —Nagle, A. F., Chicago.—Baugh, S. A., Detroit.—Fawcett, K., Alliance, O.—Roberts, E. P., Cleveland.—Forsythe, Wm., Aurora, Ill.—Webster, J. F., Springfield, O.—Swasey, Ambrose, Cleveland.—Clayton, Jno R., Dayton, O.—Baker, Charles W., New York.—Warner, W. R., Cleveland.—Colwell, A. W., New York.—Mace, L. H., New York.—Robinson, J. M., New York.—Barnes, D. L., Chicago.—Hawkins, Jno. P., Taunton, Mass.—Scheffla, Fred. A., Pittsburg—Watt, L. P., Columbus—Samuels, J. H., Moline, Ill.—Whitney, Baxter D., Winchendon, Mass.—Whitney, Wm. M., Winchendon, Mass.—Hobart, Jas. C., Cincinnati—Cullen, Jas. K., Chicago—Firestone, Joe F., Columbus, O.—Sweeney, Jno. M., Wheeling.—Weeks, Geo. W., Clinton, Mass.—Smith, Chas. F., Newark, N. J.—Laidlaw, Walter, Cincinnati—Kirby, Frank E., Detroit; Roberts, H., Detroit—Ames, Wm. L., Terre Haute—Gray, Thos., Terre Haute—Brown, C. S., Terre Haute—MacFarren, S. J., McKeesport, Pa.—Penruddock, J. H., Fort Gratiot, Mich.—Eberhardt, T. M., Newark, N. J.

Engineers' Club of St. Louis.—The regular meeting was held May 7, President Nipher in the chair; 39 members and four visitors present. The executive committee announced that the proposed celebration of the 21st anniversary would be held on the evening of the 12th inst.

Prof. Arthur T. Woods, of Champaign, Ill., then addressed the club on "Compound Locomotives." Messrs. Bryan, Johnson and Nipher took part in the discussion. Mr. Otto Schmitz then read a paper on "Granitoid Curb and Gutter." He explained the conditions of service, and gave interesting data regarding some extensive work of this kind just completed in St. Louis.

The special order of the day was taken up, being the consideration of the report of the committee on affiliation with the American Society. The report was practically as follows:

The committee, consisting of Mr. Robert Moore, Mr. Robert E. McMath, and James A. Seddon, thought that the term civil engineer embraced all classes of engineers, excepting those strictly engaged in military work. The American Society of Civil Engineers was the oldest in this country, has retained in its constitution the catholic tradition of its name, and is the best nucleus for a general organization. The committee, therefore, assume this society as a center in outlining a plan of co-operation. In regard to the mining, mechanical and electrical engineering societies, the most that can be looked for is co-operation in the matter of headquarters, offices, library, and publications.

Of necessity local organizations must be left free to manage their own affairs, particularly as to property acquired, dues and conditions of membership. The committee then presented the following as an outline of a scheme for affiliation:

1. To confer upon any body or organization of engineers, one-fifth of whose members are connected with the American Society of Civil Engineers (provided said number shall not be less than 10), the privilege of publishing its papers with those of the American Society, and of becoming, in a certain restricted sense, a branch, or a chapter, of that society, conditioned only upon the adoption of constitutions and by-laws in harmony with those of the American Society of Civil Engineers, and the observance of certain stipulations

2. Such bodies to be independent of each other, being represented in the central society, indirectly only, by such of their number as are also members of the American Society of Civil Engineers. They shall be self governing in all matters pertaining to local membership, dues and expenditures other than a subscription to the publications of the American Society of Civil Engineers, at rates fixed to cover the cost of publication and a reasonable proportion of general expenses, which subscription shall be collected by the local body and paid into the American Society treasury annually in advance, or substantially the same as is now done through the Association of Engineer Societies.

3. Professional papers submitted to the branches, and other suitable matter, shall be published by the American Society, under the same rules and restrictions as are provided for like matter originating in the American Society.

4. As the presentation of papers in either of the affiliated clubs would be a virtual presentation to the American Society, the semi-monthly meetings of the members of the society resident in New York, would be in effect meetings of a local section only, with no greater importance than is given them by the number and character of those in attendance. It would, in fact, be well to provide that the American Society as such should hold but two meetings in each year, one of them to be held in the city of New York and the other at any other place which may be selected. At these meetings all business affecting the general interests of the society should be transacted, whilst all routine business should be conducted by an enlarged board of directors.

The committee also submitted a form of a constitutional provision to be adopted by the American Society. Briefly stated, this form provided that any association of engineers applying for recognition as a branch society, must have at least 25 members, not less than 25 years old, who are eligible as members, associates or juniors, and of this number 10 must become members or associates of the American Society. Such applicant must have completed its organization by the adoption of a name, which shall not contain the corporate name of the American Society, a proper constitution, by-laws, etc., and have elected its proper officers. The remainder of the provision outlines the form of application, specifies obligations, and permits the branch to withdraw from the American Society when it so decides by vote; or it can be expelled for non-performance of obligations. The recommendation was discussed and adopted by vote as the sentiment of the club, and the American and local societies are to be notified of this action.

Engineering Association of the Southwest.—Meeting held at Nashville, Tenn., on May 8, Dr. W. L. Dudley, presiding. The report of the Executive Committee on the matter of affiliation with the American Society of Civil Engineers, which had been referred to the committee at the April meeting, was presented. The report recommended that the association maintain its independence in all matters of business management, ownership of property, and qualifications for membership, but favors an affiliation with the American Society so far as pertains to the publication of papers, the exchange of papers and periodicals, a systematic provision by which accredited members of each organization shall attend the meetings of other organizations, and a systematic co-operation in the extension of mutual courtesies to members and strangers. After some discussion the report was unanimously adopted, and a committee composed of President John MacLeod, Secretary Olin H. Landreth, and Vice-President W. F. Foster, was appointed to represent the association before the meeting of the special committee of the American Society in New York in June, at which time representatives of the several local organizations have been invited to meet with the committee of the American Society.

Mr. George Reyer, Superintendent of the Water-Works Nashville, Tenn., then read his paper entitled "The Recent Duty Test of the Holly-Gaskill Pumping Engine at the Water-Works, Nashville, Tenn." The object of the test was to determine whether or not the engine erected at the new pumping station by the Holly Mfg. Co. was capable of pumping 10,000,000 galls. of water from the Cumberland River, the source of supply, into the reservoir on Kirkpatrick's Hill each 24 hours, and performing a duty of 82,000,000 ft. lbs. for each 100 lbs. of coal consumed on a basis of evaporation in the boilers of 8 lbs. of water for each pound of coal consumed.

The engine is a vertical compound condensing engine, having two high-pressure cylinders 33 ins. in diameter and two low-pressure cylinders 66 ins. in diameter, with overhead beams. The ends of the beams are extended beyond the high-pressure cylinder to allow the insertion of a connecting-rod pin. The lower ends of the two connecting rods are attached to the cranks which are placed at an angle of 90° with each other. A fly-wheel, 24 ft. in diameter, is placed on the main shaft, and is common to both engines. The pumps are single-acting plunger pumps, 27 ins. in diameter. The pumps are placed directly under the steam cylinders in a dry well, the distance from the base of pumps to the bed plate of engine being 58½ ft. The pump rods being an extension of the piston rods, the plungers are driven directly by the pistons, and the stroke of both piston and plunger is 5 ft. The condenser is a surface condenser, part of the water from the force main passing through the tubes of the condenser, and then back into the main, so that the water used for condensing is not wasted. There are four air pumps and four feed pumps connected to and driven by the main engine.

The water pumped was measured in the reservoir, allowance being made for leakage and evaporation. Measurements were made by the City Engineer, showing the capacity of the reservoir in United States gallons for each six inches of depth from 0 ft. to 31 ft. The arrangement used for measuring the height of water in the reservoir consisted of an electric battery and bell, a light wooden float, having a copper plate on its upper surface, a steel tape and a return wire. This was so arranged that when the end of the tape touched the copper plate the observer was notified by the bell and the reading could be taken. The boiler feed water was weighed in a tank. Records were kept of the weight of coal consumed, the ashes made, the water trapped from steam main before reaching engine and dryness of steam at engine by a barrel calorimeter. Indicator cards were taken daily. Readings were taken every half hour of the steam pressure, water pressure and vacuum guages, revolution counter, temperature of water in overflow from air-pumps, level of water in the wet well, and temperature of the water in the feed water tank. Corrections were determined and applied for leakage in reservoir and force main, rainfall during test, the water trapped from steam main, the steam used in calorimeter and in feed pumps, variations in height of water in boiler at beginning and end of test.

Results.—Duration of test, 4 days, 8 hours and 52 minutes. Total U. S. gallons pumped, 49,776,680. Average head pumped against, 268.7 ft. Actual duty of boiler and engine per 100 lbs. of coal consumed, 72,223,992 ft. lbs. Duty of engine alone per 800 lbs. of steam used, crediting engine with work done by feed pump and with heat imparted to feed water by condenser, 94,263,536 ft. lbs. Revolutions during test, 85,249. Gallons pumped (computed by displacement), 50,711,220. Resulting per cent. of slip, 1.84. Average capacity per 24 hours, 11,365,628 gallons. Actual evaporation per pound of coal from feed at 50° Fahr. to steam at 80 lbs. pressure, 6.55 lbs. Equivalent evaporation per pound combustible from and at 212 Fahr., 9.31 lbs. The paper was discussed by Messrs. A. V. Gude, of Atlanta, W. F. Foster, James Geddes, W. L. Dudley and Olin H. Landreth, of Nashville.

The discussion developed the fact that the leakage of reservoir and force main about 4 miles in length amounted, when reservoir was full or 31 ft. deep, to 507,400 galls. per 24 hours, and when the water in reservoir was only 1 foot deep the leakage of reservoir and main amounted to 197,600 galls. per 24 hours, showing that the leakage of reservoir alone was about 300,000 galls. per 24 hours, as the variation in pressure and hence in leakage in main due to the 30 ft. difference in head was quite small, since the greater portion of the length of main is under a head of over 200 ft. The reservoir is composed of solid rubble masonry walls from 32 ft. to 36 ft. high, 8 ft. thick at top, and about 26 ft. at bottom, curved in profile with concrete core throughout the full height, and was built after plans of City Engineer Jowett, and of stone taken from the reservoir site.

The programme of the evening was closed by Mr. Landreth, who exhibited and explained the working of a binocular hand level recently put on the market by a leading firm of instrument makers. The accuracy of work done with the instrument was stated to be absolutely dependent on a perfectly balanced condition of the vertical muscles moving the two eye-balls of an observer, a condition, oculists state, that very rarely exists. Mr. Landreth presented in support of his theoretical objections the result of a series of experiments with nine engineering students accustomed to precise instrumental work, but selected at random, and without any knowledge of the condition of their eyes. The mean of three settings by each student of a target at 500 ft. distance, with the instrument on a firm support, gave a maximum difference among any two of the nine observers of 2.168 ft. and a mean error for the nine observers of 0.49 ft., while corresponding settings with a Locke hand level of two settings by each student—the instrument being similarly supported—gave a maximum difference of only 0.6 ft. between any two observers and a mean error of 0.17 ft., showing the ordinary Locke level to be subject to about one-third the error of the binocular form.

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ASSOCIATE EDITORS.

GEO. H. FROST.....BUSINESS MANAGER

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COMING TECHNICAL MEETINGS.

American Water-Works Association.—Annual meeting a Chicago, Ill., May 20. Secy., J. M. Diven, Elmira, N. Y.

Western Railway Club, Chicago, Ill.—Next meeting, May 20. Rooms in the Phœnix Building. Secy., W. D. Crosman.

Engineers' Society of Western Pennsylvania.—Next meeting, May 20. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, May 21. Secy., S. E. Tinkham, City Hall.

Engineers' Club of St. Louis, Mo.—Next meeting, May 21. "River Pollution in the United States," Charles C. Brown. Secy., W. H. Bryan, 309 So. 7th St.

American Society of Civil Engineers, New York.—Next meeting, May 21. Annual convention, at Cresson, Pa., in June. Secy., John Bogart, 127 E. 23d St.

Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.—Next meeting, May 30. Secy., Clement March.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, June 2. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Next meeting June 2. "Municipal Surveys," D. W. Pike. Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Club, Cleveland, O.—Next meeting, June 3. Secy., C. O. Palmer, 92 Cedar Ave.

Western Society of Engineers, Chicago, Ill.—Next meeting, June 5. Secy., J. W. Weston, 230 La Salle St.

Association of Civil Engineers, Dallas, Tex. Next meeting, June 6. Secy., E. K. Smoot, Elm and Austin Sts.

Engineers' Club of Philadelphia, Pa.—Next meeting, June 7. Secy., Howard Murphy, 1122 Girard St.

Master Car-Builders' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 10. Secy., J. W. Cloud, Buffalo, N. Y.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, June 11. Secy., J. C. Herring, Wichita.

New England Railway Club, Boston Mass.—Next meeting, June 11. Sec., F. M. Curtis, Old Colony R. R. Rooms in the United States Hotel.

New York Railway Club.—Next meeting, June 12. Rooms, at 113 Liberty St.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, June 12. Secy., Olin H. Landreth, Vanderbilt University.

American Railway Master Mechanics' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 17. Secy., Angus Sinclair, 140 Nassau St., New York.

In response to our inquiry as to instances in which car lamps had set fire to cars as the result of a train accident, we have so far learned of the following incidents:

September, 1874, Wabash R. R. A lamp in a sleeper fell down and set fire to the car, which was entirely destroyed. There was in this case no train accident.

October, 1876, Wabash R. R. A passenger train was so derailed that several cars hung over on one side. A lamp in a day coach fell down on a seat and set it on fire, but it was at once extinguished by a trainman, with nominal damage.

Jan. 17, 1890. Rear collision on Cincinnati, Hamilton & Dayton R. R., near Cincinnati. The Superintendent of Motive Power says of this: "As regards the fire in the accommodation train, it was not caused by either the engine or the stoves, but was caused by the oil lamps in one of the cars being knocked down by the two cars telescoping together and causing the fire, the stoves in both ends of the car that was telescoped having remained bolted to their places in upright position, and no fire whatever scattered from them." This comes the nearest to a fire from lamps likely to cause death to passengers pinned in a wreck of any we have heard of. It is obvious, however, that there is some chance of mistake about it.

Jan. 22, 1890. Iron Mountain Ry. The Master Mechanic of the road says of this: "The car was an I., M. & S. combination baggage and mail, and was standing on the side track at Knobel, Ark., locked up, and no one in the car. It is supposed the lamp exploded, and set fire to the car, which was entirely consumed." This was a case of using oil below proof, or of some unknown outside interference.

A wreck on the Wisconsin Central, Feb. 15, and on the Lake Shore & Michigan Central, March 6, 1890, have been reported in the technical press as kerosene fire accidents, but we have ascertained this not to be the case. In the one case there was no fire at all, but only fear of one, and in the other the fire did not start from lamps.

An explosion of an oil lamp on the steamer Puritan in Lake Michigan, May 3, and an ignition of an oil can when used in filling a *burning* lamp on the steamer H. B. Plant, of Jacksonville, Fla., are also reported. Both are instances of reckless use of untested oil, and hence of no great pertinency.

This is a pretty small grist. There must be further incidents of the kind, which we shall hope to learn of.

OUR esteemed contemporary, *Bradstreet's*, usually very careful in such matters, has been deceived by an English "appropriation" into crediting to London *Iron* an editorial note which appeared in our issue of Feb. 22, 1889. The "Remarkable Estimate" as to the population of the now United States in 1892 was taken by us from an almost unique copy of the *Lottery Magazine*, which was published in London in 1776 and died after issuing only about three numbers. *Iron* copied our note verbatim, only altering "this country" into "the United States" and omitting, for doubtless very proper reasons, to state that the note was taken "from the original now lying before us."

A NOVEL railway pass comes to the editors of this journal, "with the compliments of MOSES LIVERMAN." It is a solid silver badge, with a view in relief of a railway climbing up the wooded sides of steep mountains; blue enamel scrolls contain the information that this is the "Rainbow Route" of the "Silverton Railroad," and engraved on the back is the name of the recipient and the number of the pass, which is good until Dec. 31, 1890. An embarrassing feature about this free pass, however, is the fact that the line over which the privilege is granted is only 13½ miles long and runs from Silverton to the Yankee Girl Mine, in Colorado, and one locomotive and one combination car will provide transportation. The line is remote, but its owners show enterprise and do not propose to hide their light under a bushel. The purpose of the road is to accommodate passenger traffic through a region of surpassing scenic grandeur, and to transact general business in a very live mining section of Colorado.

THE Panama Canal is finished at last, in the report of the Commission sent out to report on it from France, at a cost of $180,000,000 more only; some $97,000,000 of this being for actual work remaining to be done on the canal. The material on hand and work done is estimated as having a present value of $90,000,000, which is certainly a pretty small residuum from the $500,000,000 nominal and $250,000,000 actual expenditures; but small as it is we believe it to be an overestimate of the present value of the works.

The Commission estimate that seven or eight years will be required to open the canal, and the annual receipts for the first three years after opening at $7,600,000, gradually increasing to $12,200,000 at the end of twelve years after estimate. These latter estimates, we believe, to be very conservative. We shall not be surprised if they are double these amounts when either the Nicaragua or Panama canals are opened.

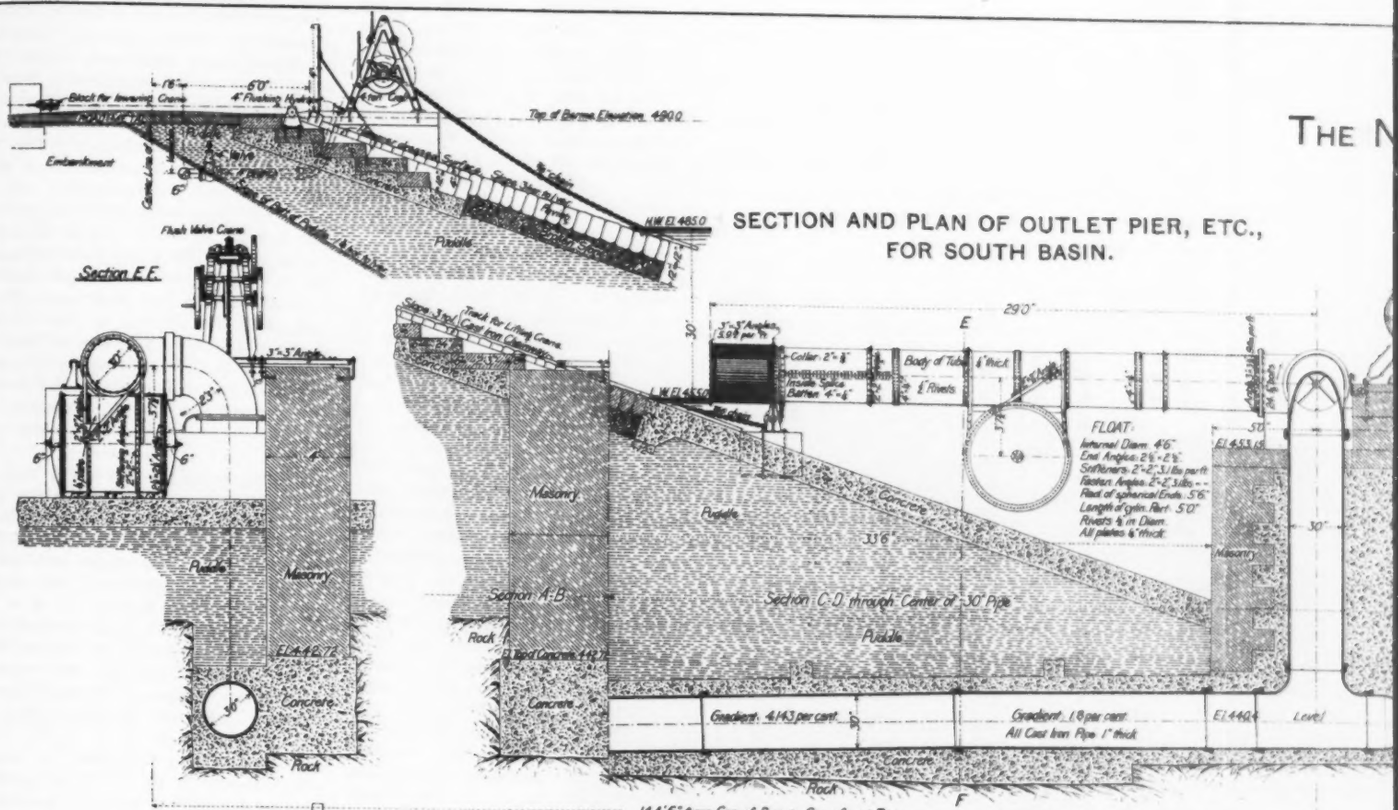
THE estimate of probable cost of completion is wholly speculative, since no man can estimate or form any exact idea of the cost of effectually controlling the Chagres River and opening the Culebra cut; but the Commission's estimate in this respect likewise seems to us a fairly close one, barring these immeasurable contingencies. It corresponds almost exactly with our own estimate of June 2, 1888, when we said:

> It appears to us that the most favorable showing which can be made for the completion of the lock canal in four years, or by June 1, 1892, would be as follows:
>
> | | |
> |---|---|
> | Excavation | $125,000,000 |
> | Eiffel locks | 25,000,000 |
> | Management and contingencies | 80,000,000 |
> | Total minimum cash outlay | $230,000,000 |
> | Against cash outlay to date | 177,810,000 |

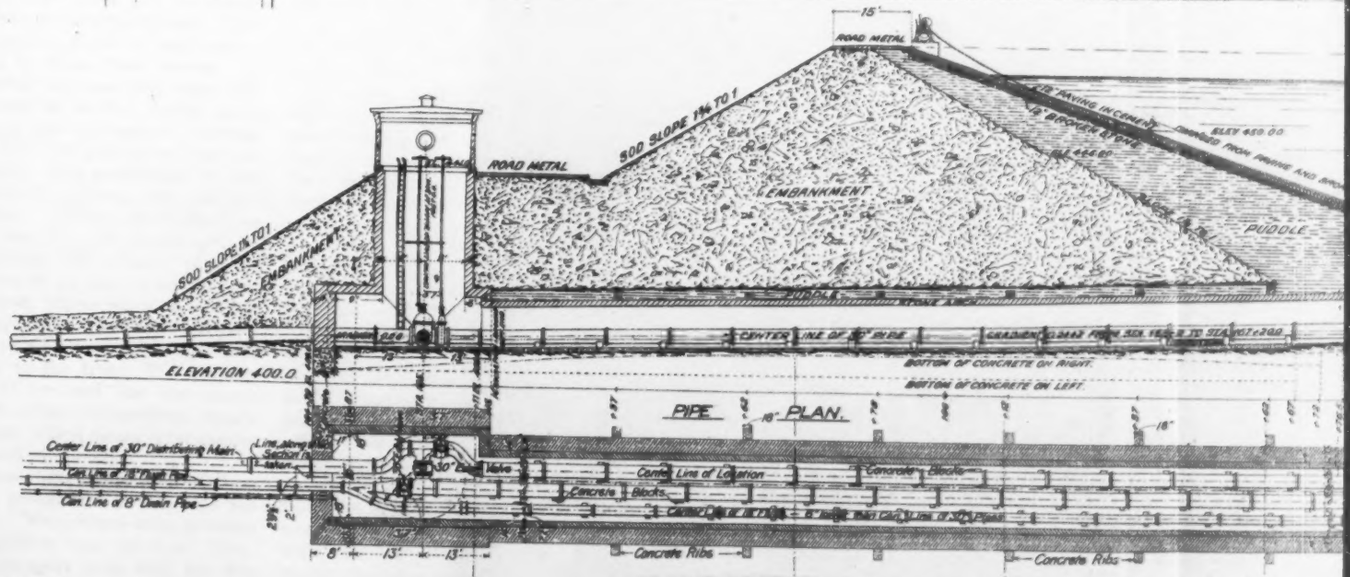
After this date work was continued until some $70,000,000 more of actual cash was expended. Adding this to the Commission's estimate of $180,000,000 still necessary makes $250,000,000 in all necessary to finish the canal; whereas our own estimate at that date, for "the most favorable showing" (good luck with Culebra and the Chagres) $230,000,000; surely a pretty close agreement, and some evidence that we did not then exaggerate unduly the case against the canal. But, whereas, we then stated explicitly that there were certain grave additional contingencies which it was absolutely impossible to estimate for, the Commission fail to do this, unless the telegraphic report does them injustice.

THE report of the Committee on a Standard Method of Conducting Duty Trials of Pumping Engines, given in full in another column, proposes a radical change from the more usual past practice, in substituting a duty unit of "1,000,000 heat-units" for the old "100 lbs. of coal." There is the plainest necessity for this in the widely varying qualities of coal, as well as in the occasional use of wood, petroleum, natural gas and other fuels not coal. As nearly as can be judged from the rather ambiguous language of the committee, the real standard which they propose is not even 1,000,000 heat-units, but rather 1,035.5 lbs. of steam evaporated from and at 212° Fahr. They say (all italics ours):

> One million heat units is a quantity of heat corresponding to that *produced* in the combustion of 100 lbs. of coal, which *gives out* 10,000 H. U. per pound, or which *produces an evaporation* of $\frac{10,000}{965.7} = 10,35\frac{5}{7}$ lbs. of water from and at 212° per pound of fuel. This *evaporative result* is readily obtained *from* 100 *lbs.* of all grades of Cumberland coals



SECTION AND PLAN OF OUTLET PIER, ETC., FOR SOUTH BASIN.

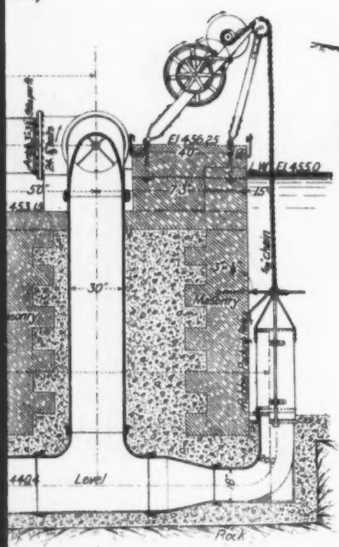


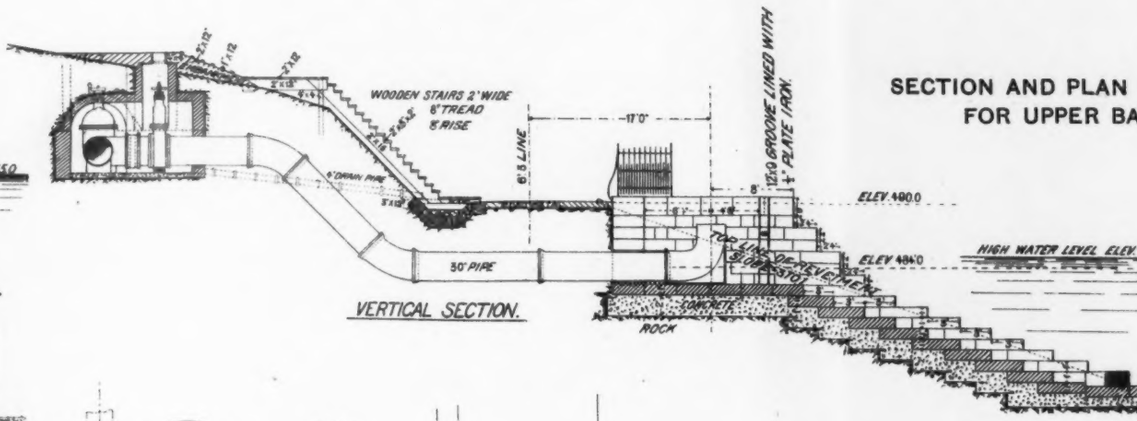
SECTION AND PLAN OF LOWER DAM.

THE NEW WATER-WORKS FOR COVINGTON, KENTUCKY.

G. BOUSCAREN, CHIEF ENGINEER.

TC.,





VERTICAL SECTION.

SECTION AND PLAN
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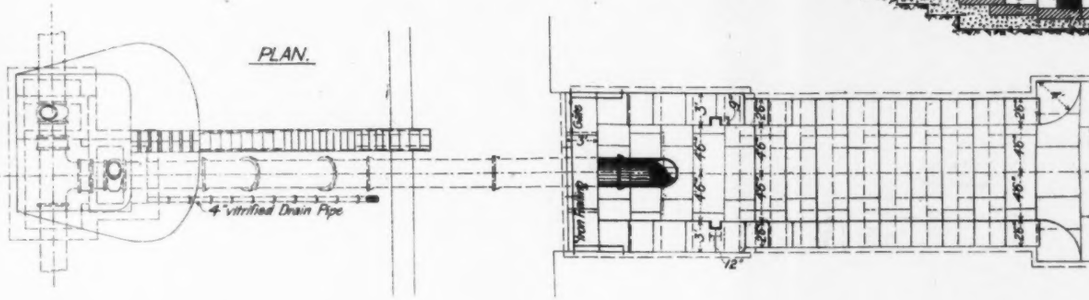

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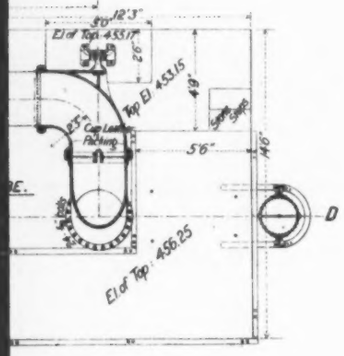
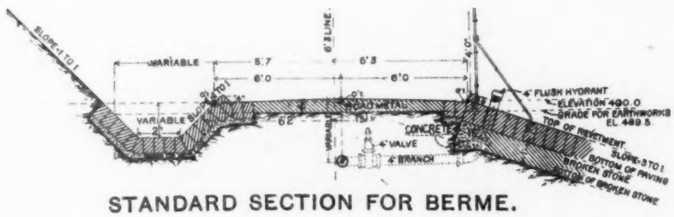
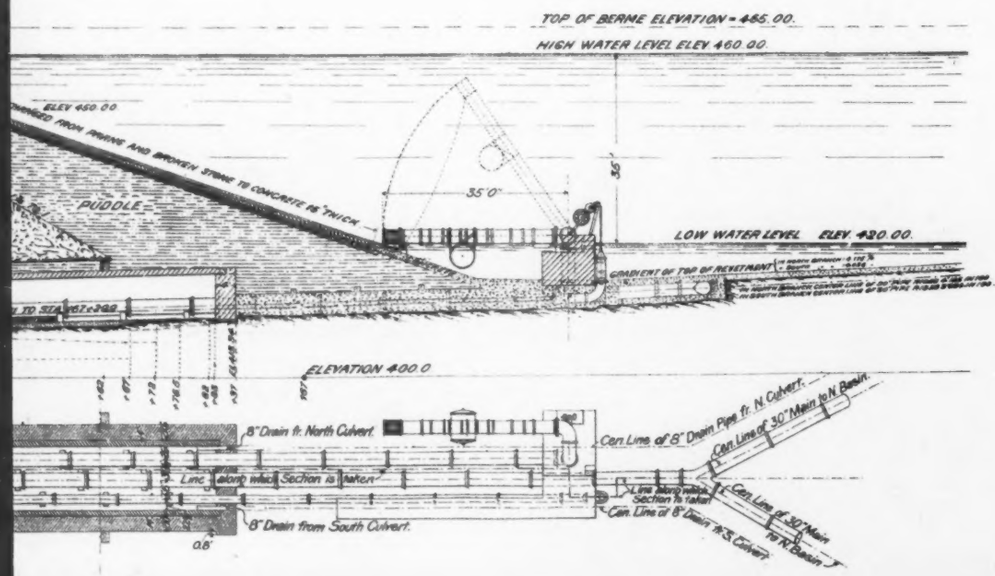
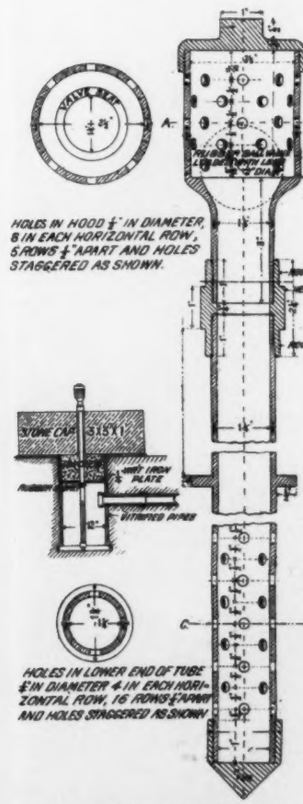




STANDARD SECTION FOR BERME.


TOP OF BERME ELEVATION = 485.00.
HIGH WATER LEVEL ELEV 460.00
ELEV 450.00
PUDDLE
35'0"
LOW WATER LEVEL ELEV. 430.00
ELEVATION 400.0
8" Drain fr North Culvert
Line along which Section is taken
8" Drain from South Culvert
Cen Line of 8" Drain Pipe fr. N. Culvert.
Cen Line of 30" Main to N. Basin.
Cen Line of 8" Drain fr S. Culvert

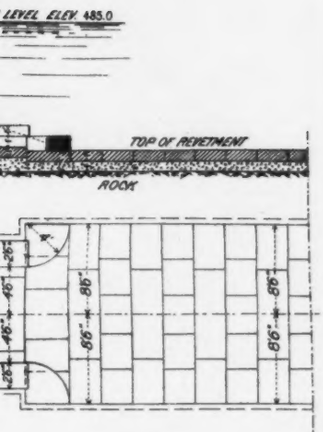


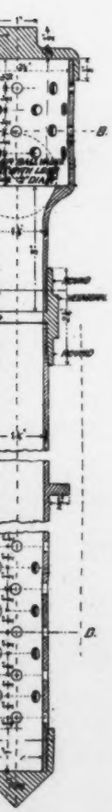
HOLES IN HOOD ½" IN DIAMETER, 8 IN EACH HORIZONTAL ROW, 5 ROWS 4" APART AND HOLES STAGGERED AS SHOWN.

HOLES IN LOWER END OF TUBE ½" IN DIAMETER 4 IN EACH HORIZONTAL ROW, 16 ROWS 4" APART AND HOLES STAGGERED AS SHOWN.

SPRING HYDRANT.

PLAN OF INLETS
PER BASINS.





RANT.

CHAS. HART & SONS, LITH., 99 VESEY ST., N.Y.

used in horizontal return tubular boilers, and in many cases *from* 100 *lbs.* of the best grades of anthracite coal.

The committee will surely perceive on reflection that this is a highly unscientific use of language, to say the least, referring, as it does, to two quite distinct things, the heat "produced" and the heat put into the steam, as if they were one and the same thing, and this confusion goes so far that it is impossible to determine, except from the context, what the committee really does mean. For just before they had been speaking of the uncertain and variable value of "100 lbs." of coal, and proposed to substitute for it "1,000,000 heat-units," which certainly implies that they propose to use as a unit the theoretical heat-units *in the coal.* This is the only way, in fact, in which the new unit can be used for tests of boiler efficiency which shall be generally comparable. With this interpretation the first half of the sentence quoted above is entirely consistent, but the last half of it is wholly inconsistent.

THE last half of the sentence above quoted expresses what seems to be really intended, however, and this should be made so clear as to be unmistakable. But even then, the form given on pages 23-5 for boiler-test reports does not seem to be consistent with this intention, for if the unit of comparison is to be units of heat put into the steam, and boiler tests are to mean anything when made with different coals and compared with each other, instead of the one line: "30. Number of pounds of coal required to supply one million B. T. U.," there should be two lines: "Theoretical value of 1 lb. of coal in B. T. U.," and "Number of heat-units produced to supply one million B. T. U." It is true that the theoretical value of the coal is often not known, but it is readily determined from a chemical analysis, and is usually already of record. To be consistent the committee should make this change in their form for boiler tests. It already requires that the moisture in the coal shall be determined.

It will also be readily seen by reading over the above quoted sentence that in the italicized clause, "*from* 100 *lbs.*," the "100 lbs." is worse than superfluous. It makes nonsense of the sentence. But with these exceptions the report seems to be an excellent document, calculated to do much in unifying practice and enabling various tests to be readily compared with each other.

THE annual statistical report of the American Iron and Steel Association, abstracted in another column, shows a continued enormous increase in our iron and steel output of nearly all kinds. Comparison with the diagram given in our issue of May 10 (which was for gross tons, whereas our figures this week are for net tons) will show how rapidly we are advancing to the leading place among nations in pig iron production. Another increase of 17 per cent. like that of last year will carry us past England. Our production of steel also increased last year 17 per cent., both for Bessemer and for "other." About one-third of our "bar-iron" is now steel; it will plainly soon be two-thirds steel. Nearly half of our "plate and sheet iron," and about 40 per cent. of our cut nails and spike are now steel. There was a slight check last year, however, in the past rapid progress toward the use of steel for all cut nails. Wire nails are coming rapidly to the front. The quantity produced increased 47 per cent. last year, and is now nearly one-sixth of the *total* product of nails and spikes of all kinds, which means a far greater proportion of the small nail product.

It is plainly because of the competition of these wire nails that the production of cut nails has fallen off so notably. Everywhere there is visible the tendency to substitute steel for iron. Thus, the rolled iron product apart from rails has only increased 7½ per cent. The rolled steel product apart from rails has increased 32 per cent. It looks very much as if steel was to become the rule and iron the rare exception with all other forms of iron, as it has with rails. The production of coal has naturally increased greatly with the production of iron, but it increased only 7 per cent. last year against 17 per cent. for iron. Anthracite fell off 7 per cent. and bituminous increased 13½ per cent., revealing a tendency which is likely to continue. Altogether, the short table in another column is well worth study.

THE Liverpool Engineering Society has a wrinkle in regard to election of officers which may well be incorporated in the revised constitution of the American Society of Civil Engineers, if such an instrument is ever submitted by the committee charged with that duty. Like most such societies it requires that there shall be more officers nominated than are to be elected, so that voters may have a chance for a real expression of opinion. By custom, if not by law, moreover, officers are elected first to the Council, then to the Vice-Presidency, then to the Presidency. Three candidates must be nominated for Vice-President, whereas only two are to be elected, which leaves the unsuccessful candidate in the unpleasant and undesirable position of being dropped out altogether. It is therefore by law provided that the "unsuccessful candidate for the office of Vice-President" shall be *ex-officio* a candidate for Member of Council, and as he is likely to be the first choice of many voters he is pretty sure of being re-elected to the council in any case. In the ballot which now lies before us there are 13 candidates in all, including this *ex-officio* nominee, of whom 8 are to be chosen. For the presidency, according to the excellent rule which prevails in the Institution of Civil Engineers, there is no formal contest, the senior Vice-President (he who the year before received the largest vote) being *ex-officio* candidate for President. In fact, he seems to be *ex-officio* President, his name not appearing at all on the ballot list before us. This seems at first sight objectionable, but a moment's reflection shows that as he has gone through the ordeal of contest successfully both to the Council and the Vice-Presidency, the voters have already sufficiently expressed their wishes in regard to him, under conditions which do not make defeat so mortifying and noticeable as in a contest for the Presidency.

Some Problems in Water-Works Design and Control.

The paper by Mr. W. R. COATS on the Water-Works of Ypsilanti, Mich., which we published last week, found, we are sure, many interested readers, although not every one may agree with the author's opinions.

As regards the Ypsilanti works, it may be conceded at once that the type of works chosen was admirably adapted to the location, and will very likely secure better and more economical results there than would have been given by any other design. With the advantages of a reliable water-power for pumping, a natural elevation of 100 ft. on which to locate the reservoir, and an abundant supply of funds for accomplishing the work, the designer of a model system of supply met with much less difficulty than ordinarily exists.

As regards the general design of water-supply systems, the questions raised by Mr. COATS' paper are most interesting, especially as the ground he takes is contrary to opinions generally prevalent among engineers.

The main point which Mr. COATS' paper opens for discussion is the question of elevated reservoir vs. stand-pipe; and he presents very forcibly and fully the argument in favor of the former as against the latter. The points which he makes with regard to the false economy in providing scanty storage, and thus making necessary the duplication of plant and continuous operation of the pumps, are very important and deserve a full discussion. As regards the loss due to continuous operation of the pumping plant, on which he lays much stress, it must be remembered that the same rule does not hold good with plants of different size. In a small city where a large proportion of the operating cost is due to the salaries of attendants, it will be found much more economical to run pumps only during the day. On the other hand, where a great amount of capital is invested in a large plant, no good reason can be given why it should do only half duty and lie idle 12 hours out of 24. In this case continuous operation will be found much the most economical.

As regards the location of the pumps and stand-pipe, whether they should be together or remote from each other, the reasons urged by Mr. COATS in favor of the latter practice are very weighty. No doubt where a reservoir forms a part of the works it should be located at a point remote from the pumping station, not only because of the much better fire streams secured, but because in this way the city has in effect two independent sources of supply. An accident to either the main near the reservoir or the main near the pumps leaves the other to supply the city while the break is being repaired. But, as regards the small stand-pipe which is often erected, neither of these reasons are of much weight, simply because its capacity is not great enough to permit it to do much more than equalize the pressure on the pumps. In the case of a small stand-pipe, the fact that if it is set at the pumping station no additional land will have to be purchased and no one will be complaining of its proximity and possible danger therefrom, will often be sufficient to locate it there.

Considering next the construction of the elevated reservoir, it is to be remembered that at Ypsilanti this structure is set on ground elevated about 100 ft. above the pumping station. If we rightly understand the topography, this elevation alone was sufficient to give considerable pressure throughout the greater part of the city. The advocate of stand-pipes then might reply to Mr. COATS that for the $21,500 expended on the elevated reservoir, a stand-pipe could be erected 115 ft. high and perhaps 25 ft. in diameter, and this would hold 70,000 cu. ft. against 43,200 cu. ft. in the elevated tank. In case of emptying the reservoir to fight a large fire, such a stand-pipe would deliver as much water from the upper 72 ft. of its height as the entire capacity of the tank, and still have 26,800 galls. available in the lower part of the tank, though of course it is under a less head, and practically only about a half could be considered effective in fighting fire.

It really seems that the question whether elevated reservoir or stand-pipe is the more economical structure to secure a given storage is one which can only be decided by a careful estimate for each location, and will be decided differently in different cases, according to the cost of iron and of masonry. In these matters, of course, great variations occur. There are many localities where good building stone, or even brick, to say nothing of the masons to lay them, would cost very much more than at Ypsilanti, while a steel stand-pipe could be bought at a moderate price. On the other hand, there are many places where good building stone is abundant, but remoteness from the iron centers would make a stand-pipe a very expensive structure.

It is perhaps true, however, as Mr. COATS asserts, that American engineers have built stand-pipes in many places where an elevated reservoir would have been both a more economical and a more efficient structure. We trust his paper will serve to call the attention of water-works designers to the merits of elevated tanks.

Two points in regard to these structures on which Mr. COATS does not touch it seems well to bring out. It is certainly true that the elevated reservoir may be made far superior to a stand-pipe in architectural effect. The Ypsilanti tower, while perfectly plain in form, is still, if we may judge from the photographs, a far more pleasing object

in the landscape than a stand-pipe 40 ft. in diameter and 115 ft. high could possibly be.

In the second place, it seems quite clear that, other things being equal, the less the natural elevation available as a location for the reservoir, the greater will be the advantage of the elevated reservoir over the stand-pipe. On a site considerably elevated, like that at Ypsilanti, the lower part of a stand-pipe's capacity is of considerable value for storage; but on a flat prairie this does not hold good, and it would seem almost always best to build a masonry structure of some height to carry the tank unless the expense of stone is prohibitory. Mr. COATS' criticisms of the stand-pipe, it will be seen, therefore, apply most effectively to those located in flat sections, where indeed stand-pipes have been principally used.

With the main statement of Mr. COATS' paper as to the excellent system of water supply which Ypsilanti now possesses no one will disagree. As he well says, the natural advantages aiding in the work were very great. Not every town has an unfailing supply of pure water from underground sources, ample water power to pump it, and a hill 100 ft. high on which to place a reservoir. Neither has every town the public spirit or the good credit to raise $140,000 on its bonds to supply itself with water-works and electric lights. Where a town possesses both these latter qualifications, and has a city government honest enough and wise enough to carry out a large scheme of public improvement, it may well refuse all offers from private corporations and go ahead to build and operate its own public works. But when a city is poor and deeply in debt, and its government is in the hands of political schemers, it must adopt whatever plan is feasible. If it cannot raise money and arouse enterprise enough to build its own water-works, it had better make a bargain with the best and most reliable company it can find, granting it the franchise for a term of years, and employing a responsible engineer, both to advise it in making the contract granting the franchise and to supervise the construction of the work on the city's behalf.

This plan, if honestly carried out, should secure, and often has secured, good results. The plan of giving away franchises with few restrictions for the sake of favoring real estate interests has in almost every case given serious dissatisfaction to the city sooner or later.

We could give literally hundreds of instances where cities which have turned over to a private corporation the matter of water supply have suffered seriously from bad quality, insufficient quantity, frequent accidents to a cheap distribution system or extortionate rates, and have been practically unable to remedy the evils.

On the other hand, there are great numbers of towns, which own and control their own water-works, which are suffering from some or all of these evils, simply because politics rule in the city government, and the people have no mind to vote taxes for the improvement of their works, knowing that the lion's share will be captured by boodlers. In this case, however, affairs are not really so bad as when a franchise has been granted, since the people have the remedy in their own hands if they choose to apply it.

But one feature of this rather discouraging outlook engineers should not fail to note. With the growing lack of public confidence in municipal officers and the increasing jealousy of corporations in connection with public works, comes the demand for men whom the public can trust. There is discernible, we hope, some tendency in the public to repose more confidence in engineers and to pay respect to the opinions of professional experts rather than newspaper interviews with "distinguished citizens" entirely ignorant of the first principles of engineering science.

When public opinion will not permit a franchise to be granted or carried out without the advice of a competent engineer, and will demand that, in the construction of works by the municipality, an engineer worthy of the name be placed in charge, we may expect better results from either public or private ownership and management than now obtain. To bring about that desirable state of affairs, however, the engineering profession must make itself even more deserving of such confidence. Its members must make for themselves a reputation not only for professional ability, but for absolute honesty in the interests they are called on to serve.

It is not too much to say that the profession deserves a far better reputation in this regard than it now has. This is partly because men have posed as members of the profession who were both incompetent and dishonest. It is partly because too little responsibility has been intrusted to engineers, as in the case of the new Croton Aqueduct, where a work admirably planned by the engineers is executed with wholesale fraud on the part of the inspectors, over whom the engineer was not permitted to have the necessary control.

There is need that engineers should set a higher value on their reputation, and refuse to assume responsibility for work unless full authority is given them to root out any attempts at dishonesty on the part of subordinates. A lack of foresight or an error of judgment may be condoned, but the public will not, and ought not, to forgive or forget the betrayer of a public trust; and they do not discriminate between the engineer whose hands were tied while the stealing went on and the inspectors who participated in the theft.

When the public comes to have more confidence in both the ability and the integrity of the engineering profession, there will be less inclination to entrust public works to private corporations.

The Study of Statistics in Technical Schools.

The astonishingly rapid development of historical and economical studies in this and foreign countries has encouraged the introduction of the study of statistics as a recognized course in our colleges and technical schools, and the Johns Hopkins, Harvard and Pennsylvania Universities, Columbia College and the Institute of Technology in Boston, have already made a good beginning in this direction. President FRANCIS A. WALKER, of of the last named institution, has as much as any other one man advocated and demonstrated the value of statistical knowledge, and in an able article in the February number of the *Technology Quarterly* he points out the advantages of such a course in our schools.

Briefly stated, and disregarding their value as a means of discipline, these advantages are given by Prof. WALKER, as follows: First, to enable the student to detect fallacies in conclusions drawn by others from quantitative statements concerning human affairs, actions, or interests, in which adventitious elements lie concealed, or from which something essential, or at least relevant, has, by inadvertence or dishonest design, been excluded. Second, to enable the writer or speaker upon politics, economics, history or sociology safely and effectively to illustrate and emphasize his conclusions, drawn from a study of a subject in itself mainly or wholly non-statistical. Third, statistics may, under proper direction and with safeguards, be used in the discovery of social laws.

These are weighty advantages, though only a lifetime of diligent study, backed by a retentive memory and an analytical mind, would give full value to the first named in the list above. But the second and third results of such study are worth almost any degree of hard work in themselves to any one whose calling in life would enable him to make use of such knowledge. Statistics in themselves, carelessly culled and used without judgment, are dangerous tools to play with, and may lead to untold mischief. They deceive not only the user, but the general reader, for a goodly array of figures are usually accepted as fundamental facts, and the conclusions built upon them go unquestioned. Some writer, whose name we forget, says: First, be well grounded in theory and then find your statistics to back the theory. A bit of advice, too, often followed, as can be at any time tested by reading the two sides of any social, economical or historical controversy.

Statistics, carelessly or dishonestly, are continually being twisted to suit the end in view, and the ability to detect and expose fallacies of this kind is a most valuable acquirement and well worthy of a special course of study. The study here proposed is no simple one; it demands elaborate previous training, is tedious, and requires the maximum exercise of patience and care and the frequent verification of data already gleaned by the student and by others. Without this patience, care and a skill only acquired by practice, the seeker after knowledge as to the relation of facts or hidden laws and causes will only succeed in entangling himself in a maze of figures to which there is no beginning and no sequence, or in deceiving himself into false deductions. The writer before quoted is right in this, that the man who seeks for figures to support his side of any question, and does so with the most honest intent, but faulty or no training at all, is very likely to be attracted first by those figures that support his views, and to ignore others which a little further labor and thought would show him, entirely altered the bearings of the case.

As Prof. WALKER says, men must be trained for this work, and in our present rapid development there is abundant room for the exercise of this training, as a general compiler of statistics, in furnishing this information to others who need it in their profession or business, or in the administration of cities and towns, and, finally, as a seeker after hidden laws, effecting, perhaps, the welfare of nations. Owing to the severe mental training required before a student can feel himself qualified for the best use of this new branch of knowledge, the number of such statistical experts would, doubtless, be small; there is certainly little danger of its ranks being overcrowded. But for the man fitted by nature for study of this character there will be plenty to do, and the world needs more trained men to properly collect and sift the rapidly accumulating facts and figures of this generation.

The required course of study is thus briefly described by Prof. WALKER: The pupil is taught to look up data relating to a given subject, as these may be found scattered through long series of reports; to bring the various statements together; to examine them as to their proper comparability; to test their accuracy by all available means, and to arrange them in tabular form. He must work out the percentages involved, and to set one class of facts into relation with others, and finally to prepare diagrams and charts which will exhibit graphically the results of his investigations. Prof. WALKER says that this branch of instruction is not yet carried as far as it ought to be, in any of the higher institutions. Still, a good beginning has been made and the growing appreciation of the true value of well-trained statistical knowledge may be depended upon in time to perfect and extend the methods of instruction.

The Proposed Brake Shoe Tests.

Some important and interesting experiments are to be made this summer by a committee of the Master Car Builders' Association, as announced by circular published in our issue of Jan. 25, 1890, to determine the comparative frictional efficiency of brake shoes of various materials, cast iron, wrought iron, malleable iron (we trust), steel, or combinations of these materials, including all brake shoes which may be offered for test in season for

the requisite preparations; and possibly some which the committee will put in by test should there be any of probable value or interest not offered for test by outside parties or by different railway companies, which is hardly likely. The tests were to have been made this spring, but have been necessarily postponed from time to time until now it is not likely that they will take place before July or August.

The committee is a strong one, consisting of Messrs. GODFREY W. RHODES, E. B. WALL and B. K. VERBRYCK; the programme is a liberal one; the apparatus is quite adequate to all the requirements, or if found deficient in any respect will doubtless be made so; and it may reasonably be hoped that the tests will shed great light on a question which can hardly be said as yet to have been investigated at all, but yet which is obviously the main question to be determined in selecting a brake shoe, viz., its comparative holding power. Its comparative wearing power is very easily determined, simply by placing shoes of different make on the same brake-beam, truck or car; and in the absence of authoritative evidence as to the other point, which is quite difficult to determine accurately, this is naturally made much of by makers of brake shoes, and is often made a reason for a change of practice. But while brake shoes are a large item of expense in the aggregate, they are a small one relatively, and no mere increase in their life should tempt a rational official to adopt a shoe of perceptibly less holding power, on financial grounds alone. This latter question, therefore, badly needs accurate determination, and we feel little doubt that it will be determined in the approaching tests as it never has been before; as also, certain of the laws of unlubricated friction.

To find any parallel for the approaching tests we must go back to the GALTON-WESTINGHOUSE brake experiments of 1876-78; a brilliant series of tests, which will be forever memorable among engineers, not only as the first scientific determination of the comparative merits and capabilities of various train brakes, but as shedding the first light of real value on the laws of brake friction; notably in showing how great is the loss of holding power when the wheels are skidded. These experiments were incomplete, however, in several respects, and hardly touched at all the question it is proposed now to determine, the comparative holding power of various shoes. So far as they went they cast discredit on wrought iron as a material for brake shoes, showing that its holding power was slightly less, and that, in addition, wrought shoes were more irregular in their action, producing jerks which threatened to damage the apparatus. The comparative coefficients of friction determined—expressly stated to be somewhat doubtful—were as follows, all the tests revealing the interesting and previously undetermined fact that the coefficient fell quite rapidly with each second after application, assumed to be due to the disintegrated particles of metal acting as rollers.

Coefficients of Brake Shoe Friction, Westinghouse-Galton Tests.

Miles per hour.	Seconds elapsed after application of brakes.		
WROUGHT IRON.	0 to 3 sec.	5 to 7 sec.	12 to 16 sec.
48	.110	.....	.....
31	.129	.110	.090
18	.170	.....	.....
CAST IRON:			
47.6	.132	.090	.070
30.6	.163	.107	.090
17.0	.205	.157	.....

One of the most promising kinds of shoes, however, in which pieces of wrought iron or steel are imbedded in cast iron, was not tried at all in these tests. It is possible that such shoes will prove to combine the merits of wrought and cast iron, by adding to their known long life great holding power. It is also possible that they will not.

In Capt. GALTON's tests the experimental vehicle was a 4-wheel van, weighing only 9.1 short tons, with 4.718 tons on the braked axle, and 4.382 tons on the unbraked axle. These are very light loads for American practice, which now very frequently rises to 10 tons per axle in freight service, and to 7 tons per axle in passenger service. An ordinary empty passenger car will have 5½ to 6 tons per axle. As the tendency is constantly to heavier axle loads, both freight and passenger, and as the very first effect of the universal use of automatic freight brakes and close couplers will be to increase the speed of freight trains on down grades and levels well up to passenger speeds, so that the action of brakes with very heavy axle loads will become increasingly important, it would, in our judgment, be highly desirable to make these tests with fairly heavy axle loads, say, an even 7 or 8 tons per axle, which can be easily done by using a little pig iron. This is especially desirable, as the Galton tests will serve as a fairly good basis of comparison for light loads.

The schedule of tests proposes that each kind of shoe shall be tested (1) on both chilled wheels and steel tired wheels; (2) on both an ordinary coach, 8 wheels braked, and on a dynamometer car, 4 wheels braked; (3) at speeds of 20 miles and 40 miles per hour, making eight different tests, and as each test is to be repeated six times, 48 different runs for each kind of shoe. This is a pretty considerable programme, and if there are six or eight different kinds of shoes to be tested (and there will be at least that), it means a fortnight or so of time, including all the inevitable delays for rain, wind, etc. A less programme, however, would not suffice to give certainty, and it is the very thoroughness of the programme which is the most hopeful feature.

It will certainly, however, be a thousand pities should so extensive a programme fail to definitely settle the whole question, and also to shed all possible light on the general laws of brake friction, as well as on the special questions involved. This is especially so if it be, as we fear, that the great difficulty in the investigation will be to secure such harmony and uniformity in the results as to determine anything positively. It may well be that minute, unrecognized differences of conditions will make as great a difference in the results as the difference in the material of the brake shoes, and this will make interpretation of the results very difficult. It has been plausibly claimed that even a difference in the amount of moisture in the air makes a sensible difference in unlubricated friction.

It is therefore highly desirable that every possible source of error should be eliminated, and every possible sidelight obtained which may aid in the interpretation of results; and it therefore seems to us that the announced programme is capable of some modifications or expansions, which we suggest for the consideration of the committee, although, very possibly, the same points may have already occurred to them or be covered by the programme. It is not necessary to enter into all such details in a preliminary announcement.

It is required that the shoes shall be furnished by competitors turned *or* ground to fit a cylindrical 33-in. wheel. Besides the difference in the surface obtained by turning or grinding, it is quite possible that some of the competitors will fail of accuracy in this respect. Moreover, the friction of new shoes is comparatively unimportant; that of shoes in their normal condition, after having done considerable braking, is what is wanted. To this end, the shoes should have been ground to the wheel by having done some considerable braking before the tests, proper, begin. This could be attained by a run of some miles with the brakes continually applied under varying moderate pressures, as in a run down-hill, taking care not to get up too much heat, and the dynamometer records of such a run would also be valuable material to show what are the varying coefficients of friction under different pressures.

This and the regular tests together would cause considerable abrasion, both of shoes and wheels, which suggests that the tests might be made to show more accurately than heretofore what is the real difference of wear. There is a make of scales—that acting through hydrostatic pressure—which will weigh even weights of tons with all the accuracy of a chemist's balance, if desired. Possibly any of the large makers could furnish such a scale capable of weighing less than a ton to hundredths of an ounce. In this case it would be well worth while to weigh both wheels and shoes before and after the tests, and the loss of each could be determined per foot-pound of work destroyed. It would possibly be discovered that some of the long-lived shoes purchased their own immunity at the expense of the wheels, which would be a left-handed economy. We know of no authoritative evidence that they do not, nor that they do, and the question should be settled one way or the other.

The brake shoe pressure is limited to the constant quantity of 70 per cent. of the load on the wheels, as nearly as may be, which is well; the tests should not be confused by variations in this respect, unless in the preliminary run before spoken of. But in view of the fact that it is only toward the end of the run that there is any danger of skidding the wheels, this 70 per cent. should preferably be secured toward the end of the stop, and the initial pressure made enough higher to secure it, in order to show what the brakes can really do, and approach nearer to probable future conditions. It is one of the oddities of science that it would be really conducive to good braking to have the brake cylinders leak a little, so that the pressure may gradually fall during a stop, if only the rate of leakage could be nicely controlled. This is owing to the fact, first determined in the GALTON tests, that the coefficient of friction is greatly less at high speeds so that a greatly higher pressure is necessary to skid the wheels. Capt. GALTON gives the following table as the necessary ratio of brake pressure to weight on wheels to produce skidding at various speeds and with various coefficients of static friction between rail and wheel; the last being nearly constant at all speeds at 0.25, but varying in cases from 0.19 to 0.35:

Ratio of Brake Pressure to Load on Wheels needed to cause Skidding.

For varying speeds and coefficients between rail and wheels.

Speed in miles per Hour.	Coefficient of Static Friction, Rail and Wheel.			
	0.30	0.25	0.20	0.15
7½	1.20	1.04	0.83	0.60
15	1.41	1.18	0.94	0.70
30	1.83	1.53	1.22	0.92
50	2.48	2.07	1.65	1.24
60	4.14	3.47	2.77	2.08

The Burlington brake tests indicated that skidding occurred somewhat sooner than these ratios indicate, but their substantial correctness is not questionable, and it will be seen that only at very low speeds is there the slightest danger of skidding. Mr. WESTINGHOUSE availed himself of this fact to construct a highly ingenious and fairly simple apparatus for automatically reducing the pressure so as to keep just within the skidding point, with which the quickest stops ever made by man were made, rising to an average retarding force during the stop of about 0.24 of the weight. It is surprising to us that the apparatus has never been put into general use, although it must be admitted that a very close approach to the stops made with it has been made by the new quick action brake, rising to 0.16 or 0.18 of the weight as against 20 to 24 per cent. with the experimental apparatus. This would seem to indicate that Capt. GALTON got too great a difference from speed, as is quite possible.

This suggests another point in which it seems quite possible that the programme might be slight-

ly modified to advantage. The proposed speeds are twenty and forty miles per hour, six stops from each. Why fix the maximum so low? In the case of the brake tests it was necessary; long trains could not be conveniently handled at higher speeds. In these tests it will be perfectly easy for the locomotive to push one car up to nearly sixty miles per hour. Now at sixty miles per hour there is just 2.25 times as much work to be destroyed by the brakes, and consequently just 2.25 times as good a chance of being able to accurately gauge, delicate distinctions of coefficient. Also, why divide twelve tests between only two speeds? It may help the unskillful spectators to strike an average quickly, but the determination of the average coefficient is so simple a matter that every end of comparison would be served by dividing up the tests between three or four different speeds, say 20, 40, and 60 miles per hour, with much better chance of determining the real laws of brake friction. In all such experiments the golden rule is: Make the conditions cover the widest possible range of conditions if the results are to be accepted as decisive. When the Burlington brake tests were first proposed there was decided opposition in the committee, and out of it, to requiring more than 25 cars to be equipped, on the ground that "25 was enough." Had this view been accepted, and 50 car trains not required, it is all but certain that the results would have been unhappily delusive. It may be that the same result will follow failing to test brake shoes at the highest working speeds.

We understand that the committee has some idea of using roller journal bearings, in order to reduce the journal friction to the lowest point possible, which may be well enough, although we hardly think the difference is important; but there is one very serious disturbing element in experiments with single cars which ought to be eliminated with some accuracy, if for no other reason than that the committee will be otherwise laying up awkward and inaccurate precedents as to the quickness with which *a train* of cars may be stopped, which might be used with telling effect against railways in suits for damages after accidents. This element is the head resistance, air or rolling, whatever it is; it is partly of both. In a single car, moving at high speed, or in two cars, this element will be very considerable, and yet no man can say just how much. It will therefore be highly desirable to let the experimental cars stop themselves by their own resistance only, without brakes, from as high a speed as it is possible to use without exceeding the limits of the level track, for two or three stops, which may be quickly made. For merely comparative purposes between the different brake shoes this will be less essential, but for accuracy even in that it will be desirable, and for scientific precision indispensable.

We trust the committee will guard themselves more carefully than they have done by any instructions which have as yet appeared, against being compelled by an implied promise to test all shoes offered, to the bitter end, even after they have become satisfied that some particular make has no promise. The programme is long enough at best; it would become intolerable if the committee had not full liberty to drop further tests of any shoe as soon as they were satisfied they knew enough about it. It is also to be hoped that some one will see to having all desirable varieties of unpatented shoes fully represented, such as hard and soft cast iron, malleable iron, and soft steel. Fortunately, the tests are in excellent hands, and we may count with some confidence on having all the points of which we have spoken, and others of which we have not spoken, duly weighed and provided for. It is not to be expected that these tests will have such great and far-reaching importance as did the Burlington brake tests, yet the light to be expected from them is of no small importance, scientifically and practically.

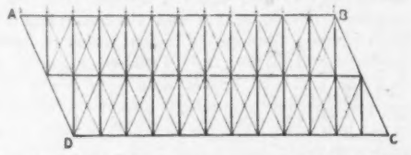
CORRESPONDENCE.

A Curious Wind Truss.

COLUMBUS, O., April 22, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I enclose a skeleton of a horizontal wind truss. I think it presents something unique in strains. The bridge on which I found it is part through and part deck. The skeleton shows the horizontal truss under the floor, and is fastened to upright end-posts at A, B, C and D. AB and CD should be shown as tension members. Now the question is, what are the maximum strains in the different pieces when the wind blows from either side? Is this a determinate problem? If not, how can the maximum strains which might occur be obtained? A SUBSCRIBER.



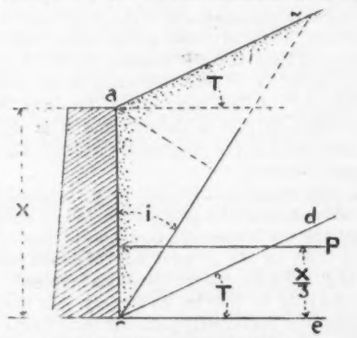
Surcharged Retaining Walls.

NEW YORK, March 3, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Will some one of your numerous readers kindly clear up what appears to be a great disagreement among authorities relative to surcharged retaining walls.

For sake of simplicity we will assume a vertical wall 10 ft. high to be backfilled with dry sand weighing 100 lbs. per cu. ft., and to have a natural slope of 25° from the horizontal. What will be the horizontal thrust per lineal foot against the wall at a point one-third of the height from the bottom?



Surcharged Retaining Wall.

Let $x = ac = ab = 10$ ft. = height of wall.
" $\epsilon = 25°$ the angle of natural slope.
" $i = 32°$ = the angle of maximum.

$$\text{pressure} = \frac{90 - \mathbf{T}}{2},$$

" W = weight of sand per cu. ft.
" P = horizontal pressure in pounds.

According to Rankine's formula, "Applied Mechanics," page 219, reduced to a horizontal thrust:

$$P = \frac{W X^2}{2} \cos^2 \mathbf{T} = 4{,}104 \text{ lbs.}$$

According to TRAUTWINE and JAMES S. TATE, both of whom quote MOSELEY, the weight of the triangle $a\,b\,c$, multiplied by $X \tan i$, which may be expressed thus:

$$P = \frac{W X^2}{2} \cos \mathbf{T} \tan i, \; P = 2{,}827 \text{ lbs.}$$

Now, which of these results, if either, is correct?

FRANK PEARL.

[*It depends somewhat on how sticky the dirt is;* but beyond this, we leave the problem to the tender mercies of our mathematical readers.—EDITOR ENGINEERING NEWS

The Chicago Exhibition Building.

TO THE EDITOR OF ENGINEERING NEWS:

SIR—I have read in ENGINEERING NEWS of April 5 Mr. THOS. C. CLARKE's criticism upon the plan of exhibition building proposed by E. S. Jenison & Co., architects, of Chicago. I think that Mr. CLARKE meant to say "the central tower would be in the position of a central pier of a suspension bridge, having two spans of 3,000 ft. each, each span carrying 185 acres of roof, etc." In other words, the tower carries all the weight of the roof, and is a very important problem in itself, if carried up to the dizzy height contemplated. Now, I admire the bold conception of the JENISON scheme, but think the plan should be cut down to more reasonable figures; and I would suggest the following: Reduce the span of the suspension cables to 1,000 ft. each way, attach them to the tower say 500 ft. from the ground, and fasten their outer ends to the roof of a circular colonnade, 500 ft. wide, the roof of which should make a continuation of the suspension curve. This would preserve the original size of the building and its general appearance, would provide an ample anchorage for the cables, and reduce the weight to be carried by them about 60 per cent. THOMAS J. WINANS.

The Ceredo Bridge Over the Ohio River.

CEREDO, W. Va., April 23, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I inclose a print showing the general outline of the Ceredo bridge over the Ohio River at Ceredo, W. Va. This bridge is being built for the Ohio extension of the Norfolk & Western R.R. Mr. W. A. DOANE is the Principal Assistant Engineer and T. KENNARD THOMSON is the Bridge Engineer. The contract for the substructure has been let to Mr. W. F. Patterson, of Pittsburg.

The work on the coffer dams and foundations will be done by force account under the supervision of WM. D. JANNEY, the Divisional Engineer at this point. The work on the foundations will be commenced as soon as the present high water subsides.

The contract for the superstructure has been let to the Edge Moor Bridge Co., and is being rapidly pushed forward in their shops. It consists as shown, of four spans of 298 ft., center to center of end pins, one of 518 ft., center to center of end pins, with an approach on the south side of the river of 70 deck-plate girder spans of 30 ft. 7½ ins., and one half-through plate girder span of 60 ft. The trusses have double bottom chords like the Wheeling bridge.

The bridge is designed for a single track, but provision has been made for a middle truss by making the bridge 34 ft. wide from center to center of trusses.

Contracts have also been let to Pencoyd and Edge Moor for about forty-five smaller bridges each, on the Ohio extension, and contracts will soon be let for one hundred more bridges. Yours respectfully,

T. KENNARD THOMSON.

The "City of Paris" Accident.

BROOKLYN, N. Y., May 10, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: After reading the first accounts of the accident to the machinery of the steamer "City of Paris," I formed my opinion as to its primary cause, and came to the conclusion that, under the circumstances, the whole matter will be as much mystified as possible. Since reading Mr. Robert Gillham's communication as published in your issue of this day, my theory is strengthened. One has every reason to take this gentleman's statement as being correct, as he states that his examination of the engine just prior to the accident was made in the presence of three well known American engineers.

He says, "We examined the cranks and crank shaft of engine, and in detail examined thrust plates, etc. The shaft ran beautifully, and the thrust plates were in perfect adjustment; bearings examined were not hot; in fact, engine and all its parts seemed in perfect working order, etc." This state of facts would certainly not have existed on an engine whose bearings were badly worn and shaft 8 ins. out of line.

Mr. Gillham's assumptions as to how the bearings might have been subsequently worn and cut, are perfectly natural, hence any attempt to prove that the accident was due to the wearing of journals and subsequent breaking of shafts prior to the bursting of low pressure cylinder seems unreasonable.

It is to be regretted that so far no one knows or had the curiosity to discover what share or proportion of the entire work of the three cylinders the low-pressure cylinder had been doing, beyond that safely assigned to it by the builders, or how far the steam pressure exceeded the factor of safety in so large a cylinder. I feel somewhat reluctant to express my opinion too freely upon this subject, but if we should consider the following facts, we might come to some conclusion.

We will now suppose that, having an abundance of boiler capacity and plenty of fuel, and a great desire to beat the record for speed, we could increase the power of the engine and consequently increase the speed, by opening a run-around or by-pass valve admitting live steam into the low-pressure cylinder, might not one be tempted to do such a thing and in so doing overdo it?

When we stop farther theorizing and take a glance at the photograph before us which shows the work of destruction, the most prominent part that meets our eyes is a half section of the low pressure cylinder separated entirely from its other half longitudinally. I can almost picture to myself the bursting in two of the large cylinder, and then, piston, piston rod, connecting rod, etc., each weighing many tons, being released from their regular confines, are carried about by the crank—which receives its motive power of destruction from the remaining cylinders—like so many flails, thrashing away at the remaining parts within their reach, until the pile of fragments form an anvil for the crank to pound upon and finish the work of destruction by grinding things to atoms.

What the condition of a shaft and its bearings would be after such a performance can well be answered by those who have had experience in repairs. Nor can we express astonishment at the condition of things as they were subsequently found. Not that I desire to criticise the work of such prominent builders as those that are capable of producing this magnificent machinery, but I do contend that large pistons, especially when working at such a high rate of speed and with such short strokes should always have two or more piston rods to distribute properly the strain on so large a surface and transmit the power from the same. ARTHUR W. L. LORETZ.

The Electrical Purification of Water.

The system here to be described, and owned and operated by the Electrical Water Purification Co., of Philadelphia, is covered by letters patent granted Messrs. LUCIUS, T. STANLEY and PHILIP P. QUACKENBOSS, and is intended to combine, in one process, all the good features of purification by oxydization, by aeration, and by chemical coagulation and precipitation. It is claimed that by this means the actual processes adopted by nature are so closely imitated as to become almost identical.

In this country and abroad millions of dollars have been expended in practically fruitless efforts to provide a practicable means of rendering contamination by sewage, etc., nil; either by eliminating from the sewage all deleterious matter before its discharge into the source of water supply, or by mechanically or chemically purifying the supply before distributing to service.

The city of London, alone, has expended more than £5,000,000, or, in other words, more than $25,000,000, during the past 20 years in this endeavor, with the result that in a report made to the Board in 1888, Mr. DIBDIN, its chemist, stated that he "has examined all the processes before the public, and was now thoroughly convinced that no process of precipitation, whatever quantity of chemicals were used, or whatever chemicals practically available were used, materially affected the dissolved matters." In 1888, Sir HENRY ROSCOE, one of the directors, in a report to the Board, says: "The only practical way in which a quantity of decomposing nitrogenous matter can be rendered inoffensive is by supplying it with an abundance of oxygen; it must not only be deodorized by the oxidation of its putrescent matter, but the resulting fluid must be as thoroughly aerated as possible." In the methods then being tried upon London sewage, while the result aimed at was to discharge a neutral effluent into the Thames, the main object seemed to be the recovery of the sewage, because of its value as a fertilizing agent.

The process adopted by the Electrical Water Purification Company is intended to directly purify the water itself by totally destroying and separating from it the organic matter with which it is contaminated; thus, differing, in every particular, from what has been done previously.

As described by the chemist of the company, this process is as follows: The form and size of apparatus used differs according to circumstances governing the volume of water to be used in a given space of time, and the character and quantity of impure matter held in solution or suspension in it. The process is based upon the combination of three methods, which have formerly been used separately, with indifferent success, in the purification of water: 1. Oxydization by aeration. 2. Oxydization and precipitation by the admixture of certain coagulants containing oxygen. 3. Precipitation by retardation.

This combination is successfully effected and rendered practicable to any extent by the use of the electric current. The action of this current is threefold:

First.—It acts to break up the water and its impurities into its original constituents, so that the further action of the process may readily collect and separate the impurities.

Second.—It acts to supply a superior oxydizing and coagulating precipitant.

Third.—It acts as a thorough oxydizing agent itself, in a manner similar to its action upon the atmosphere in producing ozone.

This threefold action is due to a primary phenomenon of electricity, called decomposition of water by electrolysis, which may be briefly explained as follows:

When the poles of a battery, dynamo or other source of current are connected to suitable metallic plates, called "electrodes," and these electrodes are immersed in a jar of water and a current of electricity set up in the circuit thus formed, the water is decomposed into its original elements, oxygen being released at the positive electrode and hydrogen at the negative. If the water is pure and a corrodible metal is used for the positive electrode, the released oxygen will unite with the metal of that electrode forming an oxide, the greater portion of which will be precipitated to the bottom, while the hydrogen released at the negative electrode rises to the surface of the water in the form of minute bubbles, and, ordinarily, escapes into the air.

If the water be impure a more complex action takes place. Suppose, for instance, the water carries chlorine, iodine, acids, ammonia, potash, soda, magnesia, etc., these being commonly found in water supplies that are contaminated by sewage and the waste from factories, etc., then, at the positive electrode, chlorine, iodine and the other acids, together with oxygen, would be set free; while, at the negative electrode, in addition to the hydrogen, there would be released ammonia, potash, soda, magnesia, etc. These elements, thus set free at either electrode, form certain soluble compounds, one with the other, determined by chemical affinity, and are duly precipitated to the bottom.

If, in addition to the above-named impurities, the water be still further contaminated by decomposing animal and vegetable matter, carrying in its mass the billions upon billions of colonies of animalculæ, bacteria and typhoid, cholera and other disease germs, which feeding upon it or upon each other, multiply at a rate past comprehension, the action of the current must be specifically directed in order to eradicate or render innocuous this disease-breeding constituent. Of all the so-called "coagulants" that have been used in ridding water of fœcal matter and its germ population, oxide of iron, in one of its forms, is acknowledged to be eminently superior because of its great affinity for animal matter, with which it readily unites when it is held in suspension in water in its vicinity. It has also the exceptional faculty of parting with a portion of its oxygen to animal matter with which it may unite.

Bearing all these facts in mind a clear understanding of the simplest form of this process may be easily arrived at. From the source of supply the water is first passed through the aerating device, wherein it becomes saturated with oxygen, thus being more thoroughly prepared for the next stage, or electrolyzation. After being thoroughly aerated the water enters the electrolyzing chamber, which is generally in the form of a chute or trough, fitted with iron. Electrodes are so constructed and arranged as to cause the water, in its passage, to take a zigzag course between them, thus causing every particle to come in contact with them and thus become thoroughly electrolyzed and charged with the oxide of iron released at the positive electrodes.

The iron salt, so released, instantly unites with the fœcal matter carried by the water, forming flocculent particles of a gelatinous character, which are carried to the top of the water by the bubbles of hydrogen, released at the negative electrodes. Here these flocculent particles unite in a mass, forming a reddish brown viscid scum, of which the major portion is, at this stage, led to waste through a properly arranged overflow, while the volume of water, continuing its course through the chute, is passed through a second ærating device, and finally discharged into a settling and distributing tank.

This second ærating device serves two purposes. It serves to restore to the water the amount of oxygen which it may have lost in its journey through the electrolyzing chute, and it serves to break up and release from the small portion of scum which may have escaped overflow in the chute, the hydrogen bubbles which have rendered it buoyant; so that, when the water is allowed to stand in the settling and distributing tank 12 to 24 hours, according to the character and quantity of impurity carried by the supply, the coagulated, flocculent particles of animal matter, now rendered innocuous by the action of the current in the electrolyzing chamber, precipitate and settle at the bottom.

The movement of coagulation, combined with the upward movement of the coagulated particles to the surface in the electrolyzing chute, together with the movement of precipitation in the settling tank, causes these particles, which, as before noted, are gelatinous in their nature, to seize upon and carry with them such particles of mud, coal dust, etc., that may be held in suspension in the water, thus acting as a perfect clarifier; so that, when the process of precipitation in the settling tank is completed, and the impurities are deposited at the bottom in the form of a reddish brown sludge, the water above is clear, pure and wholesome, and may be drawn off as desired, and, finally, when all is used down to the deposited matter, the sludge may be flushed out, or it may be allowed to accumulate for a desired period and then be flushed out. It being understood that, as the sludge is thoroughly effete, sterilized, in fact, it can do no harm by being allowed to accumulate until a convenient time arrives for flushing it out to waste.

The above explains the process as adapted to large supplies for cities, and for large manufacturing plants where there is ample storage capacity, so that while a supply is being distributed from one reservoir, a further supply may be storing and settling in a second reservoir. For smaller supplies, such as are demanded by the smaller factories, breweries, hotels, etc., the process, after leaving the electrolyzing chute, is so modified as to cause the water to be immediately distributed to service. This is accomplished by discharging the effluent from the chute into a system of retarding chambers, whereby the flocculent particles of impurity are retained for future flushing to waste at a convenient time, while the clear, pure water may be distributed to service or stored for convenient use.

The foregoing explanation of this process may be summarized as follows: (1) The water supply with its accompanying impurities is first thoroughly oxydized by aeration.

2. By "decomposition by electrolysis" the water with its soluble constituents is split up into its component parts, the soluble constituents forming new combinations and precipitating to the bottom. The water is saturated with an oxide of iron which unites with the fœcal matter, and, by parting with a necessary quantity of its oxygen, immediately sterilizes it, and, by combining with it, renders it flocculent, so that the released hydrogen carries it to the surface where the major portion of it is overflowed to waste, carrying with it all particles of mud, coal dust, etc., held in suspension.

3. By a second aeration, the effluent is recharged with oxygen to the extent of that possibly lost in the electrolyzing chute.

4. By precipitation, by standing, or by retardation, the result is a thoroughly neutral water, which may be at once distributed to service, or stored for convenient use.

The supply of electricity for the smaller plants, up to an output of 10,000 gallons per diem, may be economically taken from any direct current incandescent circuit, while for a greater output, a special dynamo is necessary. In either case the cost of maintenance is so slight compared with the service rendered as to be almost nominal. For further and more particular information, our readers should address Mr. HENRY B. CUTTER, of the Electrical Water Purification Co., 904 Walnut St., Philadelphia, Pa.

The Norwood Car Replacer.

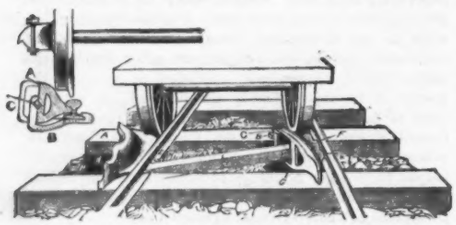
The accompanying cut shows a car replacer which is claimed, with apparent justice, to have certain decided advantages in the way of strength, lightness, handiness and simplicity. The inventor is an employé of the Baltimore and Ohio Railroad, on which road it has been quite extensively tested, and always, so far as we can learn, with entire satisfaction. It certainly is very light, a set weighing only 170 lbs., including the wooden brace, so that it is easily handled by one man under engines and in other awkward places. It has no set screws or other fragile parts to get out of order, and yet it has repeatedly replaced heavy locomotives entirely off the rails and by the use of their own steam.

The replacers are cast of iron or steel, a wood brace holding one in place, while the other is held by a clamp *B*, made by any blacksmith. The cut makes sufficiently clear the mode of use without much description. The clamp is worked under, letting it hook over the flange of the track rail, the key *C* is put in the groove of the clamp and replacers, from the front, and driven tight, and a brace put in between the rails on an angle, as shown, fitting into the pocket *G*. When this is driven tight it holds the replacer firmly, but for replacing heavy engines two or three spikes may also be desirable.

The principle on which the replacer acts is very much like that of the Latimer rerailing safety-guard, and so it does not obstruct the track, like the clumsy, swivelling wrecking frogs so often used. Hence several cars can be run on without resetting it. With pieces of old rail adjusted to the replacer several cars far off the track have been replaced at one pull in more than one instance. It will be seen

that at *A* a place is provided for firmly connecting such temporary rails to the replacer so as to bring up wheels which are far off from the rails with certainty. This alone will be seen to be a very desirable and convenient feature.

The device as a whole strikes us as one of no little merit, and certainly well worth trial. The certificates to this effect of half a dozen of the officers and employés of the B. & O. R. R. lie before us, in which are given some truly creditable instances of rapid



work in replacing. The device is manufactured and for sale by the Norwood Car Replacer Co., of 109 North Charles St., Baltimore, Md. WM. C. CODD, President, of whom further information can be obtained.

A Standard Method of Conducting Duty Trials of Pumping Engines.*

TO THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, AT CINCINNATI CONVENTION, MAY 14, 1890.

The committee of five, who were appointed at the Nashville meeting of the Society, held in May, 1888, to determine upon a standard method of conducting duty trials of steam pumping engines, have endeavored to carry out the work entrusted to them, and they beg leave to report upon the same as follows:

1. The need of a uniform system of determining the performance of pumping engines is widely recognized, and it has already been commented upon at such length in the Paper and Discussion which led to the appointment of the committee, that but little requires to be added here. The main objects to be secured by the proposed standard method seem to be, first, to establish, for the benefit of members of the Society, and of others who care to use it, a mode of determining the performance of pumping engines, which may guide them* in making tests themselves, and which, in contracts between builder and purchaser, may be specified as the mode to be followed in determining whether or not the guaranteed duty of the engine is realized; and second, to furnish a common basis, on which to compare the economy of different engines.

2. The committee has taken it for granted that the scope of its work extends over the whole field of duty trials, and that it is not confined simply to devising a suitable method for carrying on the operations of making the test.

It requires only a brief examination of the subject to see that much of the present variety of results which are obtained, and which it is desirable to overcome, is due to the varied nature of the coal unit upon which the duty is now based. In the eastern section of our country the unit of "100 lbs. of coal" may refer either to Cumberland bituminous coal or to anthracite coal, and in the middle or western section to Pittsburg, Illinois or Ohio bituminous coal. In some localities the fuel may be petroleum, natural gas, coal screenings, tan-bark or sawdust. There is a wide difference in the evaporative efficiency of these various fuels, even when of good quality, and differences of quality in the same grade of coal are the cause of still greater diversity. These variations in kind and quality of fuel, which are significant in no small degree, make the old standard unfit either for a commercial or a scientific basis for duty ratings. It is proposed, therefore, at the outset, that the existing unit, "100 lbs. of coal," be abolished, and that, in its place, a new basis, "1,000,000 heat units," be established. One million heat units is a quantity of heat corresponding to that produced in the combustion of 100 lbs. of coal, which gives out 10,000 heat units per pound, or which produces an evaporation of $\frac{10,000}{965.7} = 10.355$ lbs. of water and at 212° per pound of fuel. This evaporative result is readily obtained from 100 lbs. of all grades of Cumberland bituminous coal, used in horizontal return tubular boilers, and, in many cases, from 100 lbs. of the best grades of anthracite coal. The proposed new unit is thus, in reality, though not in name, in close accord with the existing unit, and, furthermore, it retains its numerical simplicity.

3. Considering that the two processes by which steam is generated and used are wholly distinct and independent of each other, there is a natural line of separation between the work of the boiler and that of the engine, and it is impossible to determine their individual economy if treated as a whole. There is reason here for separating the performance of the engine, in the proposed standard, from that of the boilers, and this mode of independent treatment is the one which the committee recommends. An additional reason for this course is found in the somewhat extended practice, among those who purchase pumping engines, of obtaining the boilers from independent builders.

In order that a contract may be brought into accord with this provision, where the complete plant is furnished by one party, it would be framed with two clauses relating to the performance, one referring to the duty of the engine proper, and the other referring to the evaporative duty of the boilers.

4. Starting with a heat-unit basis of computing duty, it is proposed to make the computation from the quantity of heat supplied to the complete plant; using not only that supplied to the engine cylinders, but that supplied to all the accessory parts of the engine, such as the steam-jackets, the donkey feed-pump, the independent air-pump, if this be driven with steam, and any other apparatus using steam which is necessary to the operation of the engine. It is recommended that the scope of the test be made so broad that, for the sake of completeness, the quantity of steam which passes through the cylinders of the engine be determined independently of that used for other purposes, and likewise, that the quantity of steam used by each accessory part of the engine be also determined. In contract tests, if a steam pump be used for the boiler feed-pump, the quantity of heat supplied for operating this apparatus is to be included in the total quantity, not only in cases where both boiler and engine are supplied by one party, but also where the boiler is furnished by a separate contractor. In this connection it should be added that if the engine contractor does not furnish the boiler feed-pump, he should be permitted to specify, if he desires, the kind of feeding apparatus which shall be used during the test.

The heat-unit method requires that the actual total heat of the steam shall be known, and for this purpose allowance will necessarily be made for any moisture or superheat contained by the steam furnished to the engine.

5. In determining upon a suitable method of measuring the amount of work done, which involves a measure of the quantity of water discharged into the force main, the committee has endeavored to find one which may be employed universally, and which may, in a reasonable manner, serve the ends of the builder, purchaser, and all interested parties. Plunger displacement and weir measurement have heretofore been the common means of ascertaining the quantity of water discharged. The use of a Venturi tube, so-called, inserted in the force main, has been advocated, as also the employment of nozzles, or other similar means of indirect determination. [See appendix.]

The objection to the plunger displacement method is, that, on account of "slip," which, as the committee understands, covers all the losses due to leakage of plunger and valves, to the return of water through the valves during the interval of closing, and to imperfect filling of the pump, the quantity calculated is greater than the actual discharge, and the method does not afford, in contract tests, the protection to the purchaser which his interest demands. The objection to the indirect modes of measurement, as by the use of weir, tube or nozzles, is that the person making the test must educate himself in the manipulation of the apparatus chosen, so as to be himself assured of the reliability of the data; and, furthermore, whether thus assured or not, he must compute the desired quantities by the use of coefficients, the accuracy of which he cannot himself verify, and which may not exactly apply to the precise conditions relating to the individual case in hand. There is no method thus far used or advocated which is not open to some kind of objection, and the committee is obliged to recommend a course which, though subject to criticism, appears to reduce the objectionable features to a minimum.

It is proposed that the plunger displacement system of measurement be employed, and that the purchaser's interest be protected by the determination of the amount of slip in the pump, so far as slip is produced by leakage of the plunger, which is probably its main factor, and leakage of valves, if this occurs through faulty design. It may be said that, if it were not for leakage, the pump itself, in well-constructed engines, would undoubtedly furnish the most reliable meter which could be had of the quantity of water discharged. A satisfactory determination of the approximate extent to which leakage occurs does not present serious difficulty.

In deciding upon plunger displacement, accompanied by a determination of the leakage, as the best mode of measurement for the purposes in view, the committee does not for a moment underrate the importance and desirability of measurement by weir, tube, or nozzle, whenever either of these can be employed to advantage. It is strongly recommended that these additional measurements be undertaken in all cases where it is practicable to do so, that the results of the test may be supplemented by the additional data thus obtained. [See appendix.]

6. In determining the quantity of work done by the pump, the committee recommends that the work of overcoming the friction of the water in passing through the passages and valves in the pump should not be included in the desired total; but that the work expended in friction of both the force and suction mains be included in that on which the duty is computed. It is held that the efficiency of the engine should not be made dependent upon any condition which is foreign to itself, and that the builder of the engine should be held responsible only for the work done from the time when the water enters the pump to the time when it leaves it. The purchaser, it should be observed, should guard his interest in the matter by having the mains furnished of such capacity as to reduce their friction to a minimum.

To carry out these provisions, the data to be determined, apart from that relating to the plunger displacement, are the indication of a pressure gauge attached to the force main, that of a vacuum gauge attached to the suction main, and the vertical distance between the centers of the two gauges.

It is recommended that no air be allowed to enter the pump cylinders during the progress of the test, thereby removing all possibility of imperfect filling. If it is necessary, in special cases, for air to be "snifted in," this should be regarded as a defect in the action of the pump, which should be noted by the expert in his report, and such allowance should be made for the imperfect filling, due to the presence of air, as may be determined upon by an examination of the indicator diagrams taken from the pump cylinders, or from other data which may be secured.

7. The necessary data having been obtained in accordance with these recommendations, the duty of an engine, and other quantities relating to its performance may be computed by the use of the following formulæ:

1. Duty $= \frac{\text{Foot pounds of work done}}{\text{Total number of heat-units consumed}}$

$$\times 1{,}000{,}000 = \frac{A\,(P \pm p + s) \times L \times N}{H} \times 1{,}000{,}000 \text{ (foot pounds).}$$

2. Percentage of leakage $= \frac{C \times 144}{A \times L \times N} \times 100$ (per cent).

3. Capacity = number of gallons of water discharged in 24 hours $= \frac{A \times L \times N \times 7.4805 \times 24}{D \times 144}$

$$= \frac{A \times L \times N \times 1.24675}{D} \text{ (gallons).}$$

4. Percentage of total frictions

$$= \left[\frac{I.H.P. - \frac{A\,(P \pm p + s) \times L \times N}{D \times 60 \times 33{,}000}}{I.H.P.}\right] \times 100$$

$$= \left[1 - \frac{A\,(P \pm p + s) \times L \times N}{A_s \times M.E.P. \times L_s \times N_s}\right] \times 100 \text{ (per cent.);}$$

or, in the usual case, where the length of the stroke and number of strokes of the plunger are the same as that of the steam piston, this last formula becomes:

Percentage of total frictions

$$= \left[1 - \frac{A\,(P \pm p + s)}{A_s \times M.E.P.}\right] \times 100 \text{ (per cent.).}$$

In these formulæ, the letters refer to the following quantities:

A = Area, in square inches, of pump plunger or piston, corrected for area of piston-rod. (When one rod is used at one end only, the correction is one-half the area of the rod. If there is more than one rod, the correction is multiplied accordingly.)

P = Pressure, in pounds per square inch, indicated by the gauge on the force main.

p = Pressure, in pounds per square inch, corresponding to indication of the vacuum gauge on suction main (or pressure gauge, if the suction pipe is under a head). The indication of the vacuum gauge, in inches of mercury, may be converted into pounds by dividing it by 2.035.

s = Pressure, in pounds per square inch, corresponding to distance between the centers of the two gauges. The computation for this pressure is made by multiplying the distance, expressed in feet, by the weight of one cubic foot of water at the temperature of the pump well, and dividing the product by 144; or by multiplying the distance in feet by the appropriate quantity, found in the following table. The quantities in this table are computed from the weights of one cubic foot of water at the various temperatures, as given by D. K. Clark in his *Rules and Tables*, which also correspond to Charles T. Porter's figures, in his work on the *Richards' Steam-Engine Indicator*.

Temperature of water in pump well.	Weight of 1 cu. ft. of water divided by 144.	Temperature of water in pump well.	Weight of 1 cu. ft. of water divided by 144.
Deg. Fahr.		Deg. Fahr.	
32	.4335	75	.4325
35	.4335	80	.4322
40	.4335	85	.4319
45	.4334	90	.4315
50	.4333	95	.4311
55	.4332	100	.4307
60	.4331	105	.4303
65	.4329	110	.4298
70	.4327		

L = Average length of stroke of pump plunger, in feet.

N = Total number of single strokes of pump plunger made during the trial.

A_s = Area of steam cylinder, in square inches, corrected for area of piston rod. The quantity, $A_s \times M.E.P.$ in an engine having more than one cylinder, is the sum of the various quantities relating to the respective cylinders.

L_s = Average length of stroke of steam piston, in feet.

N_s = Total number of single strokes of steam piston during trial.

* Committee report to the American Society of Mechanical Engineers at the Cincinnati meeting of May, 1890.

M. E. P. = Average mean effective pressure, in pounds per square inch, measured from the indicator diagrams taken from the steam cylinder.

I. H. P. = Indicated horse power developed by the steam cylinder.

C = Total number of cubic feet of water which leaked by the pump plunger during the trial, estimated from the results of the leakage test.

D = Duration of trial, in hours.

H = Total number of heat units [*B. T. U.*] consumed by engine = weight of water supplied to boiler by main feed-pump × total heat of steam of boiler pressure reckoned from temperature of main feed-water + weight of water supplied by jacket-pump × total heat of steam of boiler pressure reckoned from temperature of jacket-water + weight of any other water supplied × total heat of steam reckoned from its temperature of supply. The total heat of the steam is corr cted for the moisture or superheat which the steam may contain. For moisture, the correction is subtracted, and is found by multiplying the latent heat of the steam by the percentage of moisture, and dividing the product by 100. For superheat, the correction is added, and is found by multiplying the number of degrees of superheating (*i. e.*, the excess of the temperature of the steam above the normal temperature of saturated steam) by 0.48. No allowance is made for heat added to the feed-water, which is derived from any source, except the engine or some accessory of the engine. Heat added to the water by the use of a flue heater at the boiler is not to be deducted. Should heat be abstracted from the flue by means of a steam reheater connected with the intermediate receiver of the engine, this heat must be included in the total quantity supplied by the boiler.

The total and latent heats may be found by reference to the tables of the Properties of Saturated Steam, given in Table No. 1 of the Appendix. The quantities of heat contained in one pound of water at various temperatures are appended in Table No. 2. These tables are copied from Charles T. Porter's treatise on the *Richards' Steam Engine Indicator*. The pressures here given are reckoned from zero Fahrenheit. To convert the gauge pressure to that referred to the zero basis, the barometic pressure is to be added to the corrected indications of the gauge. When the barometer indicates 29.92 ins., the pressure to be added is 14.7 lbs. per sq. in. For other indications of the barometer, the corresponding pressure may be found by using the multiplier 0.491. [Two imaginary examples of the use of these formulas are then given, which we omit. EDS.]

[*To be continued.*]

Iron and Steel Production for 1889.

The statistical report of the American Iron & Steel Association for 1889 is more voluminous than any of its predecessors for several years. It contains full information concerning the course of the American and foreign iron trades during 1889 and in the early months of the present year. It shows that 1889 was a prosperous year for iron and steel manufacturers on both sides of the Atlantic, and that the world's production of pig-iron and steel in that year was much larger than in any preceding year. So far, this year has been rather unfavorable as respects prices, both here and abroad, but consumption is active.

The report contains tables showing the production of iron ore, coal, pig-iron and steel by all countries, from which it appears that the United States now produces 26 per cent. of all the iron ore that is mined, 26 per cent. of all the coal, 30 per cent. of all the pig-iron and 32 per cent. of all the steel that is manufactured. The world's annual production of iron ore is placed at 53,289,000 tons; of coal, 462,000,000 tons; pig-iron, 24,869,000 tons; steel, 10,513,000 tons. The world's production of pig-iron has increased 76 per cent. since 1878, and its production of steel has increased in the same period 248 per cent., the figures for 1878 being respectively 14,117,000 tons and 3,021,000 tons.

The following is a general summary of the statistics for the United States for 1889, as compared with 1888, all in *net* tons of 2,000 lbs., except as stated. We add the approximate percentage of increase:

	1888.	1889.	Per ct. Incr.
Pig iron, net tons	$7,268,507	$8,516,079	17
Spiegeleisen, net tons	54,789	85,823	57
Bar iron, net tons	1,819,585	2,016,030	11
Bar steel, net tons	772,017	1,051,447	36
Wire rods, iron and steel	313,341	407,513	30
Plate and sheet iron	469,312	471,193	00
" " steel	213,694	331,283	55
Cut nails and spikes	324,020	290,538	(— 11)
Steel " "	216,174	201,634	(— 8)
Wire rails	75,000	110,000	47
All rolled iron, ex rails	2,397,402	2,576,127	7¼
" steel "	1,201,885	1,584,364	32
Bessemer steel rails	1,552,631	1,691,264	9
Open hearth "	5,261	3,346	Decr.
Iron rails	14,252	10,258	Decr.
Bessemer steel ingots	2,812,500	3,281,829	17
Open hearth steel ingots	352,036	419,488	19
Crucible "	78,713	84,969	8
Blister & pat'd "	4,124	5,734	39
All kinds crude steel	3,247,373	3,792,090	17
Iron blooms	39,875	36,200	Decr.
Value imports, iron and steel	42,311,689	42,027,742	Decr.
" exports, " "	19,578,489	23,712,814	21
Imports, iron ore, gross tons	587,470	853,573	45
Domestic, " " " "	12,062,530	14,096,427	17
Product, Anthracite coal, gross tons	38,145,718	35,407,710	(—7)
Product, Bituminous coal, gross tons	85,529,053	97,011,632	13½
Product, all kinds coal, gross tons	123,674,771	132,419,342	7.

AN ENORMOUS TWELVE STORY BUILDING is to be erected in Chicago, 190 × 350 ft. on the south half of the block bounded by Dearborn, State, Monroe and Adams streets. The total area of the floors will be nearly 19 acres, and it is expected that all of it will be used by the general retailing establishment, known as "The Fair," now occupying the site with small buildings. The building will be the largest in Chicago, larger even than the Auditorium, and by far the largest of the kind in the world.

A FULL-FLEDGED MINE AT THE CHICAGO FAIR is seemingly seriously proposed by an enthusiastic Colorado engineer, says the *Chicago Times*. The plan outlined, which is unaccompanied by an estimate of cost, is to sink a 1000-ft. shaft and fit it with commodious elevators. Then in bottom drifts are to be shown, by minerals artificially placed, all types of mining operations. In other drifts steam and compressed air drills are to work, explosives are to be actually used, and the pumping, lighting, ventilating and hoisting plants are to be actual exhibits. The lower main gallery would be lined and supported by blocks of various marbles and other building stone to be exhibited. The scheme has novelty, certainly, but while possible is very improbable in its fulfillment.

THE LONDON EIFFEL TOWER PROPOSITION has brought out a prolific crop of designs from various countries. The heights proposed range from 1,197 ft. to 2,007 ft., and while some of them have architectural beauty, none excel the original Eiffel Tower in grace and structural fitness, and the majority are ridiculous. Mr. MAX AM ENDE presents a gothic design in latticed steel, 1,550 ft. high, which is spoken of as exceeding the rest in architectural form. But it is too ecclesiastical to suit the purpose intended; and gothic windows, 300 ft. high, which light nothing and have no legitimate purpose, are absurd as adjuncts of a structure, the chief object of which is to serve as a dignified and properly proportioned framework for elevators intended to lift people above the smoke of London. The Eiffel Tower was really little more than this; but it performed its office gracefully and with a dignity purely its own.

THE NEW 5,500-TON CRUISER, for the building of which bids are to be opened on June 10 next, will have the following dimensions:

Length on mean load water line	330 ft.
Breadth, extreme	53 ft.
Draught of water, mean	21 ft. 6 in.
Displacement on normal draught	5,500 tons.
Indicated horse power	13,550
Speed	20 knots.

The protective deck is to be 4¼ ins. thick on the inclined and 2 ins. on the flat portions over the machinery. There will be accomodations for 25 officers and 440 men. The engines are designed to develop 13,500 H. P. at the maximum speed of 20¼ knots per hour. There will be twin screws. The main battery will consist of two 8-in. and ten 4-in. breech-loading rifled guns. The two 8-in. guns will be located on the center line in barbette turrets 4 ins. thick; and the 4-in. guns will be mounted on central pivot carriages and be protected by fixed segmental shields 4 ins. thick. The secondary battery will consists of eight 6-pounders, six 3-pounders, and 14 machine guns mounted to be clear of the main battery. Wherever possible 2½-in. plate will protect these guns.

THE LEARY DOCK SCHEME, for St. Johns, N. B., has been adopted by the Common Council. The improvement contemplated includes a timber dry-dock, practically on the well-known Simpson plan. The proposition comes from Mr. JAMES D. LEARY, of New York.

THE "JOHN SCOTT" GOLD MEDAL has been awarded by the Franklin Institute, of Philadelphia, to the Colt's navy revolver as improved by Mr. CARL J. EBBERTS, of Hartford, Conn. The chief new feature is a so-called "cartridge pack," by means of which the six cartridges can be inserted into the chambers by one motion, the cylinder swinging out laterally to meet this requirement.

CHICAGO STREET-CLEANING is to be hereafter supervised by a special committee of seven Aldermen, according to a resolution of the Council of May 12.

THE DETROIT RIVER TUNNEL is pronounced feasible, by the Army Board referred to in our last issue, at an estimated cost of $3,500,000, exclusive of land damages, and for a single track tunnel.

THE ARTESIAN WELL recently bored at Velasco, Texas, has struck good, soft, flowing water at a depth of 440 ft.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Pittsburg & Western.—Henry W. Hardman, of Beaver Falls, Pa., President, writes us as follows concerning the Ellwood Short Line R. R., mentioned as projected in our issue of May 3:

The road is projected as a short cut for the Pittsburg & Western R. R. through the city of Ellwood to Rock Point Station, a distance of about 4 miles. The surveys have been completed, and construction is now in progress. There will be a 700 ft. tunnel and two bridges on the line. It is expected that tracklaying will begin in August, and the road completed by Nov. 1. Paul Didier, of Pittsburg, Pa., is Chief Engineer.

Lehigh Valley.—Chief Engineer Paul S. King is reported as saying that work would be commenced on the Buffalo & Geneva R. R. in a few days. The contractors are now getting their plant in position.

American Midland.—It is rumored that the recently incorporated New York, Fort Wayne & Chicago R. R. Co. will secure control of this road at the June sale.

Canada.—Notice has been given of resolutions granting or renewing the following railway subsidies: Vaudreuil & Ottawa Ry., additional, $96,000; Waterloo Ontario Junction Ry., $35,200; for a railway from Woodstock, Ont., to Chatham, $256,000; St. Catharines & Niagara Ry., $44,800; Morrisburg & Ottawa Ry., $166,400; Erie & Huron Ry. $70,400; Brockville & Westport Ry., $83,000; Manitoulin & North Shore Ry., $96,000; Port Arthur, Duluth & Western, $16,000; Lake Erie & Detroit River Road, $16,000; Lindsay, Ontario & Bobcaygeon Ry., $51,200; Kingston & Ottawa Ry., $115,200; Ottawa & Parry Sound road, $96,000; Bay of Quinte & Lake Nipissing Ry., $96,000; Cobourg & Pacific Ry., $96,000; St. Stephen, New Brunswick & Milltown Ry., $11,200, and Woodstock, New Brunswick & Centreville Ry., $19,200; Fredericton to Westfield station, 30 miles, $96,000, and New Brunswick Central Ry., for 4 miles, $14,400; railway from Shelburne, N. S., to Annapolis, via Liverpool, $290,000; Inverness & Richmond, Ry., 50 miles from Hawkesbury to Broadlove $52,000; International Ry. Co. (additional), $3,840; Montreal & Sorel Ry., $40,000; Pontiac & Pacific Ry., $24,000; Montreal & Lake Maskinonge Ry., $10,200; Great Eastern Ry., for bridges near Nicolet, P. Q., $37,500; Drummond Co., P. Q., $76,800; Joliette, P. Q., & St. Felix Ry., $48,000; Lake Temiscamingue Ry., $64,000; Mount Orford, Ontario & Kingsville Ry., $67,200; Maskinonge, P. Q., & Nipissing Ry., $48,000; Jacques Cartier Union Ry., $48,000; Valleyfield, P. Q., Huntingdon Ry., $36,000; Quebec Central Ry., $288,000; Lake St. John, P. Q., Ry., $68,400; for a railway from Summerside to Richmond Bay, $9,600; Stewiacke Valley Ry. (renewal), $80,000; railway from Fredericton, N. B., towards Prince William, $70,400; St John Valley Ry., from Prince William towards Woodstock, $70,000; Kootenay Valley Ry., $150,000; St. John Valley & Riviere du Loup, $70,400. The total amount of the subsidies to be voted is $3,324,000. It is probable that a supplementary list will be published soon.

Canada & St. Louis.—Press reports state that the Vanderbilts have secured control of the property of this company and will operate the completed portions as feeders to the Michigan Central and the Lake Shore & Michigan Southern railways.

Toledo & Ohio Northern.—The following item is from the Cleveland *Leader*, of May 8:

The Vanderbilts, while at Cleveland yesterday, made a new and somewhat startling move. They organized a company to build a line from Fayette, O., to Chesterton, Ind., near Chicago. For some weeks a very active scheme has been working at Toledo to build another road from that city to Chicago, which, if built, would invade most valuable Lake Shore territory. A counter move on the latter's part therefore became the only alternative to a division of business. The Fayette branch, or the old Chicago & Canada Southern road, is already started. It is an unprofitable stretch of track, extending from Detroit southwesterly to Fayette, Fulton Co., Ohio. The Lake Shore bought it years ago to prevent its extension at that time to Chicago. At the meeting yesterday the Toledo & Ohio Northern and the Indiana Northern Railroads were organized, the object being to extend the Fayette Branch to Chesterton, Ind., the distance being, perhaps, 150 miles. The cost, roughly estimated, will be $3,000,000. The stock is subscribed mainly by the Vanderbilts. The following Board of Directors was elected: Cornelius Vanderbilt, Fred W. Vanderbilt, William K. Vanderbilt, John Newell, Dan P. Eells, J. H. Wade, P. P. Wright, E. D. Potter, Jr., and C. P. Leland. Mr. Newell was elected President and C. P. Leland Secretary and Treasurer.

Pennsylvania.—It is announced that surveys are in progress for a railway to run from Fannettsburg, Pa., across the mountains to Newville, on the Cumberland

Valley R. R. The line will run just north of the old South Pennsylvania, and is, it is stated being surveyed in the interest of the Pennsylvania R. R. Co. This company will build branches from Hecla to Mount Pleasant, Pa., and from Stewart to Murryville, Pa.

Concord & Montreal.—This company will build a short extension of the Pemigewasset Valley branch.

Maine Shore Line.—It is reported that a locating survey of this road will soon be commenced.

Cincinnati, Wabash & Michigan.—Oliver Ferguson & Co., of Bedford, Ind., have secured the contract for building the branch from Anderson to Rushville, Ind. Work will commence at once and be completed by Aug 15.

Projects and Surveys.

Neville Island.—Incorporated in Pennsylvania to build a line of railway from Pittsburg upon and over Neville Island to Coraopolis, Pa., a distance of 14 miles. David Smith, of Jarentum Borough, Pa., is President.

Shawmut & Brandy Camp.—Chartered in Pennsylvania to build a line of railway, 2½ miles long. B. E. Cartwright, of Ridgway, Pa., is President.

Chest Creek.—This company has been chartered in Pennsylvania to build a railway from Westover to Carrolltown, Pa., a distance of 10 miles. John Patten, of Curwensville, Pa., is President.

New York & Ohio.—We are informed that Benjamin F. Holmes, of 45 Broadway, New York City, is President of this road, and not D. M. Yeomans, as stated in our issue of May 8. F. K. Peck, of Hudson, O., is Chief Engineer.

New York, Fort Wayne & Chicago.—The Secretary of State has granted articles of incorporation to the New York, Fort Wayne & Chicago Railroad Co., whose principal office is at Cincinnati. The company will construct a road from the east boundary of the State in Mahoning Co., and extending westerly through the counties of Mahoning, Portage, Summit, Medina, Ashland, Huron, Seneca, Hancock, Putnam and Paulding. The capital stock is $50,000 and the incorporators are C. B. Matthews, F. H. Baldwin, John Carlisle, Drausin Wulson and Joseph B. Foraker.

New Albany Belt & Terminal.—Chief Engineer John MacLeod, New Albany, Ind., has completed the survey for this road, and it is probable that construction will be commenced at once. It is stated that the money necessary to build the road has been secured and that the road will be completed as soon as possible.

SOUTHERN.—Existing Roads.

Wrightsville & Tennille.—W. B. Thomas, of Tennille, Ga., President, writes us that the surveys have not been made for the extension, from Dublin to Abbeville, Ga., 40 miles. The route is through a fine timber and agricultural country affording easy grades and curves and light work. There will be a steel draw-bridge 280 ft. long over the Oconee River at Dublin. The contracts for the bridge will be let soon. The principal business of the road will be in lumber, cotton, naval stores, and general merchandise.

Memphis & Atlantic.—F. M. Abbott, of West Point, Miss., President, writes us as follows:

This road is projected to run from Memphis, Tenn., via Oxford, Houston, West Point, and Columbus, Miss., and Carrollton, Ala., to Tuscaloosa, Ala., a distance of 230 miles. The surveys have been completed and the section between West Point and Houston, Miss., 30 miles, is under construction. The work averages about 17,000 cu. yds. of earthwork per mile; maximum grade 40 ft. per mile, and maximum curve 4°. The principal traffic of the road will be in agricultural produce, cotton, lumber, coal, iron, and general merchandize. The right of way has been partly secured and other local aid to the amount of $500,000 obtained. Maj. Belton Mickle, of West Point, Miss., is Chief Engineer.

Roanoke & Southern.—At a meeting of the stock holders of the Virginia & North Carolina Construction Co., recently held, the following officers were elected: F. H. Frees, of Winston, N. C., President; W. A. Lemey, of Winston, Secretary and Treasurer, and directors, John Gill and Geo. C. Jenkins, of Baltimore, Md.; J. W. Hanes and R. J. Reynolds, of Winston, and L. P. Harper, of Suffolk, Va. An option to construct the Roanoke & Southern R. R. from Martinsville to Roanoke, Va., was ordered taken up, and work pushed.

Nashville, Chattanooga & St. Louis.—The proposed extension of this road, from Dunlap to Pikeville, Tenn., has been located, and it is stated construction will commence June 1, and that the road will be completed by Jan. 1, 1891.

Knoxville Southern.—Steps are to be taken to secure the extension of this railway from Blue Ridge, Ga., south east to connections with the Atlantic coast. A company was chartered during the last session of the Georgia State Legislature to build the road, and a meeting of the incorporators will be held soon to make arrangements for commencing work. There will be about 72 miles of new railway to construct, comprising a line from Blue Ridge to Gainesville, 50 miles, and a line from Jeffersonville to Athens, Ga., 22 miles.

Gainesville & Dahlonega.—W. A. Charters, Receiver, will sell this Georgia company's properties at public uction on July 1. The property consists of 15 miles of rade; right of way and franchises from Gainesville to Dahlonega, 25 miles; 3 miles of completed track, and a bridge spanning the Chattahoochie River, near Clarksville, Ga.

Georgia, Carolina & Northern.—The graders of this road have reached a point near Athens, Ga.

Middle Georgia & Atlantic.—It is expected that the grading between Machen and Covington, Ga., will be completed by July 15. The estimated cost of the work is $70,000.

Nashville, Chattanooga & St. Louis.—This company has secured a renewal of the option on the Tennessee & Coosa R. R., now in operation from Gadsden to Attala, Ala., 11 miles. The road is projected to run from Gadsden to Huntsville, Ala., 65 miles, and will be a valuable feeder to the N., C. & St. L. if purchased.

Orlando & Lake Jessup.—Tracklaying is rapidly progressing on this Florida road.

Savannah, Americus & Montgomery.—This company is securing right of way and terminal facilities for its proposed extension to Montgomery, Ala. The road is now completed from Louvale to Sterling, Ga., where connection is made with the Central R. R. of Georgia, over whose tracks the company enters Savannah. The completion of the line to Montgomery will give the company a through line from Montgomery to the seaboard.

Georgia, Carolina & Northern.—This road is now open for traffic from Monroe, S. C., to Fish Dam. Tracklaying has been completed to Tiger River, five miles beyond Fish Dam.

Projects and Surveys.

Georgia, Tennessee & Illinois.—The surveys for this road have been completed as far as Cave Springs, Ga., a distance of 34 miles. A party will soon be organized to survey the division between Tallapoosa and Rock Mart, Ga. L. F. Bellinger, of Tallapoosa, Ga., is Chief Engineer.

St. Albans & Coal River.—Mr. P. O'Hern, of Charleston, W. Va., President, has furnished us with the following information concerning this enterprise:

The road is projected to run from St. Albans, W. Va., via Forks of Coal, Boone C. H. and Logan C. H., to a connection with the Ohio extension of the Norfolk & Western R. R. on the Kentucky State line. The surveys have been completed, and a greater part of the right of way has been secured. The length of of the road and its branches will be about 200 miles. The work is generally favorable. There will be two tunnels of about 600 ft. each and four bridges. No contracts will be let except for the construction of the tunnels and bridges. It is expected that tracklaying will begin upon the first division of 20 miles by Sept. 1, and that this portion of the line will be open for traffic by Oct. 30. The company was chartered in June, 1888. Wm. Reynolds, of Charleston, W. Va., is Chief Engineer.

Bennettsville & Society Hill.—We have received the following information from J. J. Lucas, of Society Hill, S. C.

The preliminary surveys have been completed for this road, which is projected to run from Bennettsville to Society Hill, S. C., a distance of 11 miles. The present highway between these places will be followed closely by the railway and will afford a very favorable route. There will be a considerable bridge work and trestling. The object of the road is to give Marlboro County an outlet to Charleston. The principal traffic will be in cotton, phosphate and general merchandise. The company was chartered in December, 1889.

Burkesville & Northwestern.—We have received the following information from H. A. Genung, Burkesville, Ky., Chief Engineer:

This road is projected to run from Burkesville to Horse Cave, Ky., or from Burkesville to Glasgow, Ky., depending upon which route is shown to be the most advantageous by the surveys. The line from Burkesville to Horse Cave, 46 miles, has already been surveyed, and surveys are now in progress for the line from Burkesville to Glasgow, about 40 miles. The work will be generally heavy; maximum grade, 90 ft. per mile, and maximum curve 6°. There will be several small bridges and two tunnels 1,150 ft. in length each. The greater part of the right of way will be donated and other aid will be asked from the towns along the route. The principal business of the road will be in oil, timber and minerals. It is expected that the contracts for construction will be let within 60 days. W. F. Alexander, of Burkesville, Ky., is President.

Savannah Terminal Co.—A company by this name is to be formed at Savannah, Ga. The object of the company is to build docks and wharves and to supply terminal facilities for railways entering the city.

Kentucky.—Bills are before the Kentucky Legislature to incorporate the Oil City Railway Co., to construct a railroad from Bowling Green to Hogdensville via Oil City; J. C. Evans, J. Ritter, J. A. Hindman and others are the incorporators; to incorporate the Bowling Green & Southern Railroad Co.; to incorporate the Kentucky River & Virginia Railroad Co.; to incorporate the Jellico & Munfordsville Railroad Co.; to incorporate the Jellico, Kentucky & Lexington Kentucky Railroad Co.; to incorporate the Three Forks Belt Line Railroad Co.; to authorize Cumberland county to subscribe to the stock of the Burkesville & Northwestern Railroad Co., and to incorporate the Central City Mineral Railroad Co.

Brunswick, Steinhacher & Gulf.—Incorporated in Florida to build a railway from Georgia State line to Deadman's Bay, Fla. Among the incorporators are: P. A. McIntosh, W. S. Ivey, J. F. White and H. M. Wood.

Macon & Dublin.—At a meeting of the stockholders recently held the following officers were elected: President, D. M. Hughes; Vice-President, H. S. Morse; Secretary and Treasurer, Hardy Smith, of Dublin, Ga. Considerable work was done some time ago, but the enterprise was dropped and nothing has been done for some time. It is stated that there is some talk of trying to revive the project.

SOUTHWEST—Existing Roads.

Gulf, Brazos Valley & Pacific.—We are indebted to Mr. G. B. Gurley, of Waco, Tex., Chief Engineer, for the following information concerning this enterprise:

The road is projected to run from Velasco, Tex., at the mouth of the Brazos River, along the valley of the river to Mineral Wells, Tex., and thence north through Jack Co. to Henrietta, Tex., a total distance of about 400 miles. Surveys are now in progress between the Texas & Pacific Ry. in Parker Co. and Henrietta. Construction is now in progress from the Texas & Pacific Ry. to Mineral Wells, 10 miles. The company is building this 10 miles itself, but the remaining 80 miles of the line to Henrietta will be built by contract, and bids will be called for in about one month. The route is through a fine farming and mineral country, affording easy grades and curves and very light work. There will be one bridge 450 ft. long on the line. The principal business will be in cotton, grain, coal, timber, live stock and minerals. About 90 miles of the right of way has been obtained. It is expected that tracklaying will begin on the division now under construction about June 1, and that the road will be opened for traffic in July. The company was chartered in February, 1890. C. W. White, of Waco, Tex., is President, and H. M. Taylor is Secretary.

Omaha, Hutchinson & Gulf.—H. L. Jackson, of Kingman, Kan., Chief Engineer, writes us as follows concerning the southern extension of this road from Kingman, Kan., to the Indian Territory line:

The maximum grade of the extension from Kingman, Kan., south will be about 1 per cent. with compensation for curvature, and the maximum curve will be 3°. There will be two bridges on the line. The line has been located and the contract has been let to John S. Wolf & Co., who have the grading nearly finished and about 20 miles of track laid. About 400 men and 200 teams are now at work on the line, and it is expected to have it in operation by June 15.

Chicago, Rock Island & Pacific.—Press dispatches state that tracklaying on the Wichita Valley Ry. has reached a point 15 miles from Wichita Falls, Tex., toward Seymour, Tex. The grading has been completed for 30 miles, and it is expected that the force will return to Wichita Falls and commence work on the line north to meet the line being built from Ft. Reno, Ind. Ter., south.

Missouri Pacific.—This company will issue $7,000,000 of bonds out of an authorized issue of $10,000,000, the money to be used in paying off the floating debt and providing funds for new construction.

Missouri Pacific.—Right of way is being secured for the extension of the Minden Branch from Minden to Webb City, Mo., and ultimately to Granby, Mo.

Kansas City, Ft. Smith & Southern.—The surveys for the extension of this road from Splitlog, Ark., south, have been completed, and grading is now in progress. It is expected that the grading will be completed to Sulphur Springs, Ark., by July 1.

Paris, Choctaw & Little Rock.—S. J. Wright, of Paris, Tex., President, has furnished us the following information concerning this road:

The road is projected to run from Kiomatia, Tex., to Hot Springs, Ark., a distance of about 200 miles. About 40 miles of this distance has been surveyed, and surveys will be resumed soon. The route is through fine timber regions in Texas and Arkansas, and it is expected that the road will obtain a good traffic in lumber, cotton, minerals, and general merchandise. It is expected that work will be commenced this summer. B. J. Baldwin, Jr., is Secretary.

Projects and Surveys.

Joplin & Western.—Incorporated in Missouri to build a railway from a point on the Kansas State line via Joplin, to a point on the Indian Territory line, a distance of 15 miles. Among the incorporators are: S. H. H. Clark, Geo. C. Smith and W. H. Phelps.

Oakville & Eastern.—The citizens of Oakville, Tex., have organized a company to construct a line of railway from Oakville, Tex., east to a connection with the Southern Pacific R. R., at a point near Beeville.

St. Joseph & Southern.—The route of this road has been located from St. Joseph to a point about 20 miles west of Excelsior Springs, Mo.

NORTHWEST.—Existing Roads.

Fremont, Elkhorn & Missouri Valley.—This company has completed arrangements for the construction of two extensions comprising about 30 miles of railway. One line will run from Whitewood to Deadwood, So. Dak., and has been put under contract, as stated in our last issue. The other line is to run from Buffalo Gap to Hot Springs, So. Dak. This line will be costly owing to a 1,800 ft. tunnel.

Chicago, Milwaukee & St. Paul.—It is reported that this company is considering an extension from Elgin to Dundee, Ill.

Duluth & Winnipeg.—General Manager W. H. Fisher is reported as saying that work would soon begin on the further extension of this road to the International boundary. Surveys are now in progress.

Port Arthur, Duluth & Western.—It is stated that work will be commenced at once upon the branch to Kakabeka Falls, Ont.

Black Hills & Fort Pierre.—McDonald & Penfield, of Fremont, Neb., contractors, are pushing work on this road, which is projected to run from Lead City, So. Dak., to Piedmont, on the Fremont, Elkhorn & Missouri Valley R. R. It is expected that tracklaying will begin about July 20 and that the road will be in operation by August 1.

Chicago, St. Paul, Minneapolis & Omaha.—This company has filed notice of its intention to extend its line from Neillsville to Marshfield, Wis., about 25 miles.

Projects and Surveys.

Milwaukee Avenue Alley.—Incorporated in Illinois to construct a line of railway from Canal St. northwest to

Lawrence Ave., in Chicago. Among the incorporators are Edward Weissert and Andrew C. Lanshen.

Duluth & Northwestern.—It is stated that arrangements have been completed for floating the bonds of this company, and that all the necessary arrangements for the commencement of construction will soon be completed.

Black River Falls & Eastern.—Surveys are reported in progress on this Wisconsin railway. A. S. Cooper, of Black River Falls, Wis., is Chief Engineer.

Pierre, Duluth & Black Hills.—A press dispatch says that a number of Eastern capitalists have made a proposition to the citizens of Pierre, So. Dak., to iron and equip this road between Pierre and Aberdeen, No. Dak., if the city would grade the roadbed. About $200,000 have already been subscribed toward the grading fund, and it is expected that grading will begin in about a month.

ROCKY MT. AND PACIFIC. Existing Roads.

Canadian Pacific.—It is reported that this company will shortly send out an engineering party to locate a line through the Crow's Nest Pass westward from Fort Macleod. A preliminary examination of the proposed route was made last year. The line intersects the present line beyond the Gold range. The engineering party will be out all summer.

Projects and Surveys.

Calgary & Edmonton.—The Canadian Government proposes to grant this road a subsidy of $80,000 a year for 20 years, and a land grant of 6,400 acres per mile. The road is projected to run from Calgary to Edmonton, Northwest Territory, a distance of about 200 miles.

Wallace & Sunset.—Surveys are in progress on this Idaho railway, a notice of whose incorporation was given in our last issue. It is expected that construction will commence about June 1.

Wardner Mining.—A railway company by this name has been chartered in Idaho, to build a railway from Wardner Junction southwest to mines, a distance of about 15 miles. The principal place of business is Wardner, Idaho.

Olympia & Gray's Harbor.—Incorporated in Washington to build a line of railway. Among the incorporators are: W. H. Owings, F. D. Hustis, W. H. Calkins and C. H. Prescott.

FOREIGN.

Tehuantepec.—Active work is reported on the National Tehuantepec Railway, being built for the Federal Government. Seventy kilometers are in operation eastward from Salina Cruz, on the Pacific Ocean, and 108 kilometers are ready for the rails. Work is going on satisfactorily west from Coatzacoalcos.

Sierra Majola.—This company proposes to build a railway from Satillo to San Yzadara, Mex.

RAPID TRANSIT.

Street Railways.—At McKeesport, Pa., an ordinance has been passed giving a right of way to the McKeesport, Reynoldton & Dravosburg Ry.

The street railway at Orlando, Fla., has been sold to N. Poynts for $1,033. The road is to be extended and improved.

The contract for the construction of the street railway at Merrill, Wis., has been let to M. K. Gochnauer, of Appleton.

The Rapid Transit Co., of Salt Lake City, Utah, has been granted a franchise for a new line 5 miles long.

Elevated Railways.—At Chicago, Ill., the Forsyth Elevated Ry. Co has been incorporated by Jacob Forsyth, Sheffield, Ind.; John J. Forsyth, Sheffield, Ind.; George W. F. Forsyth, Sheffield, Ind.; Oliver O. Forsyth, Sheffield, Ind., and Henry F. Moore, Chicago. Capital stock, $5,000,000.

At Milwaukee, Wis., the Milwaukee Ave. Elevated Ry. Co. has been incorporated to build a road commencing at Canal St., between Madison and Fulton Sts., running north between Fulton and Kinzie, thence northwest to the line of Lawrence Ave. Capital stock, $5,000,000. The incorporators are as follows: August Meyer, John M. Krause, Edward Weissert and Andrew C. Lausten, of Chicago, and Ferdinand Haussen, of Grayland, Ill.

Electric Railways.—The Holliston Electric Ry. Co., of Holliston, Mass., has been organized by G. A. Flagg, A. L. Forbes, G. B. Fiske and others. Capital stock, $25,000.

At Springfield, Mass., work is progressing on the Thomson-Houston electric railway.

The Flushing & College Point St. Ry. Co., of Flushing N. Y., has applied for power to adopt electric traction, using overhead wires.

The electric railway at Charlotte N. Y., will be about two miles long, with four turnouts. The road will be operated on the Short system.

A syndicate has been formed of New York, Elizabeth and Brooklyn capitalists, with the object of securing a franchise to build an electric railway in the northern part of Elizabeth, N. J. There are three other companies which want the same territory through which to run horse railways. The syndicate is said to have the consent of the majority of the property owners concerned.

Ross Township, Pa., expects to have an electric road. Active steps are soon to be taken looking to the construction of a street railway to Bellevue, and an application is now being prepared for a charter for the Allegheny & Westview Ry. Co. The incorporators are James W. Breen, Fred. Schwitter, J. J. Flannery, J. B. Rogers and John O'Neil. The capital is fixed at $15,000, but this will in time be increased to $100,000 when the work of building the branch line which will form the complete system is begun.

The Homestead & Connecting Electric Ry. Co., of Homestead, Pa., has been organized by I. N. Burchfield, J. D. Scully and A. Carnegie. Capital stock, $300,000.

The contract for the construction of the electric railway at Greensburg, Pa., has been let to Frank Cloppfer, of that city.

The Maysville St. Ry. & Transfer Co., of Maysville, Ky., will adopt an overhead wire electric system.

The City Council of East St. Louis, Ill., has granted a franchise to the East St. Louis Electric Ry. & Power Co., to construct a street railway. The line will commence at the levee on Broadway, passing up to Collinsville Ave. and St. Clair Ave. to Cahokia Creek. Cross lines will also be built on Illinois Ave., Tenth St. and on Main St. and Converse Ave.

The St. Louis & East St. Louis electric car line has been built over the Eads bridge and will be extended through East St. Louis this summer.

At San Antonio, Tex., a franchise of an electric railway with overhead wires, has been granted to a syndicate of Denver capitalists.

The Metropolitan Electric Ry. Co., of Butte, Mont., has been incorporated by W. P. Wear, F. E. Sargent and M. B. Brownlee, to build a road to Walkerville.

HIGHWAYS.

New Jersey.—At Newark, N. J., the Road Board has awarded contracts for broken stone as follows: J. H. Marshall, Springfield Ave., $1.57 per gross ton; John O'Rourke, Frelinghuysen Ave., $2.20; John O'Rourke, South Orange Ave., $1.83; John O'Rourke, Central Ave., $1.69; George Spottiswoode, Park Ave., $1.75; George Spottiswoode, Bloomfield Ave., $1.80; George Spottiswoode, Washington Ave., $2.19. A resolution was adopted providing that contractors who furnish broken stone for the repair of avenues shall have the same weighed upon the public scales, or in case the contractor weighs the stone upon his scales, the weigher shall be required to make affidavit that the weight which is marked on the ticket accompanying the stone is correct, and when the stone shall be delivered the contractor shall give a duplicate stone ticket to the superintendent of the avenue on which the stone is delivered.

New Jersey.—The following proposals for the construction of roads in Union County have been received by Mr. F. A. Dunham, Engineer of County Roads, Plainfield, N. J. The quantities are as follows: No. 1, 20,847 sq. yds of Telford or macadam pavement and 6,456 cu. yds. of excavation; No. 2, 25,371 sq. yds. and 9,151 cu. yds.; No. 3, 1,957 sq. yds. and 250 cu. yds.; No. 4, 14,117 sq. yds. and 3,000 cu. yds.

Bidders.	Pavement per sq. yd.	Excavation per cu. yd.	Total for excavation.	Total for pavement.	Grand total.
	$	cts.	$	$	$
1. North Ave., Cranford Township:					
B. M. & J. F. Shanley.	1.40	40	2,582.40	29,185.80	31,768.20
Lightype & O'Reilly..	1.35	30	1,936.80	25,958.75	27,995.55
Hoffman & Hetfield ..	1.04	30	1,936.80	21,680.88	23,617.68
E. N. Lynch.	.87	80	5,164.80	18,136.80	25,301.60
T. A. Nevius	.95	30	1,936.80	19,804.65	21,741.45
J. A. Weldon, Jr.....	1.17	31	2,001.36	24,390.99	26,392.35
2. North Ave., Union Township:					
B. M. & J. F. Shanley.	1.40	40	3,660.40	35,519.40	39,179.80
Lightype & O'Reilly..	1.25	30	2,745.30	31,713.75	34,459.05
E. N. Lynch	.90	30	2,745.30	22,833.90	25,579.20
T. A. Nevius	.95	30	2,745.30	24,102.45	26,847.75
3. West Jersey St. and Bay Way, City of Elizabeth:					
B. M. & J. F. Shanley.	1.23	40	100.00	2,407.11	2,507.11
E. N. Lynch.....	.98	45	112.50	1,917.86	2,030.36
J. N. Weldon, Jr.....	1.15	29	72.50	2,250.55	2,323.05
4. Morris Ave., Springfield Twp:					
Lightype & O'Reilly ..	.95	30	900.00	13,411.15	14,311.15
Jno. A. Hicks.....	1.10	35	1,050.00	15,528.70	16,578.70
E. N. Lynch.	1.08	30	900.0	15,246.36	16,146.36
T. A. Nevius	.90	30	900.00	12,705.30	13,605.30

West Virginia.—The Board of County Commissioners-Wheeling, has awarded contracts as follows for macadamizing county roads: First-class roads.—N. Nickerson, $1.20 per cu. yd.; Wm. Springer, $1.16; Bowman & Bowman, $1.28, $1.15; W. M. Hutchinson, $1.30; R. P. Glass, $1.31, $1.49; A. Williams, $1.35; Thos. Smith, $1.35; S. Abercrombie, $1.04, 99 cts.; W. M. Moore, 89 cts.; Smith & Maxwell, $1.15; Henry Herwig, 88 cts.; E. Bowman, $1.28; D. Nickerson, 90 cts.; Nathan Venaman, 92 cts.; I. B. Van Fossen, $1.25; F. Muldoon, $1.37; Hand & Kiger, $1.55; David Hercules, $1.05; S. Wallace, $1.09; L. Phillips, $1.40; Wm. Schockey, $1.22. Second-class roads.—H. P. Carter, $1.20; N. Venaman, $1; Wm. Ray, $1.10; Geo. O. Hervey, 97 cts.; Chas. Sontag, $1.25; John Anderson, $1.30; W. Maxwell, $1.40; Wm. Springer, 95 cts.; W. F. Carter, $1; J. H. Briggs, $1.40; Wiley Cox, $1.13; W. H. Austen, $1.14; W. H. Hutchinson, $1.10; M. Mitchell, $1.50; J. Bowman, $1.35; E. Lyle, $1; H. Heimberger, $1.25; H. Henderson, $1.38; J. Anderson, $1.60. Geo. Amos, 20, 35 and 40 cts. for excavation, $2.75 for culverts, $2.95 for bridge masonry.

WATER-WORKS.

NEW ENGLAND.

Derry, N. H.—Wheeler & Parks, of Boston, have been awarded the contract to construct a system of works. Operations will be commenced as soon as their contract at Cottage City, Mass., is completed. Articles of agreement between the Derry Water-Works Co. and the town call for a complete system of works ample to supply the villages of Derry and Derry Depot with water for the extinguishment of fires and for all domestic and manufecturing uses. There will be 4¼ miles of pipe, the principal main being 10 ins. in diameter. Forty hydrants will be set, and sufficient head is guaranteed to afford at the the centre of the town not less than five streams forced simultaneously to a height of 50 ft. through 200 ft. of 2½-in. hose. Beaver Pond will probably be the source of supply.

Greenfield, Mass.—The Water Board has voted to extend the 6-in. mains. James Porter has been re-elected Superintendent.

Bradford, Mass.—A new 1,000,000-gall. reservoir is being constructed by Thomas P. Connery.

Jamestown, R. I.—Town Clerk Weeden has called a special town meeting for the purpose of taking action for providing the town with a system of works. It is proposed to set about 20 hydrants.

MIDDLE.

Hoosick Falls, N. Y.—Trustees Eldredge, Bannon, Holmes, Murray and Sheridan have been appointed committeemen to ascertain the most feasible method of bringing pure water into the town by gravity.

Syracuse, N. Y.—The bill authorizing the city to take its water supply from Skaneateles lake has become a law.—It is reported that the Water Commissioners have offered the water company $800,000 for their plant.

Rochester, N. Y.—Authority to carry out the conduit plan for increasing the water supply was not obtained from the Legislature, now adjourned.

Troy, N. Y.—A resolution has been passed ordering the extension of mains from Fourth St. along Lincoln Ave.

Newark, N. J.—The North Hudson Co. R. R. Co. will lay a considerable amount of cast-iron pipe to replace cement pipe.

Monongahela City, Pa.—The City Council has arranged with the water company to put in 20 fire plugs.

Beaver Falls, Pa.—Two new pumping engines, each having a daily capacity of 2,000,000 galls., will be purchased to supply Rochester, 3 miles below, with water. An order has recently been placed for two pumps of like capacity for supplying Beaver Falls with water. Work has been commenced on the new pump house, in which they are to be erected. It will be located on the east side of the new dam at Fetterman. The Beaver Falls works will be known as the Union Water Co. Both the Valley Water Co. and the Union Water Co. are owned by the "Pittsburgh Company," the last controlling large interests aside from these companies, including the new town of Elwood.

Rochester, Pa.—The Town Council has contracted with the Union Water Co., of Beaver Falls, Pa., for furnishing a water supply.

Chambersburg, Pa.—A vote will be taken upon June 10 to decide the question of issuing $35,000 of bonds for purchasing new pumping engines and constructing a new reservoir. The surveys and estimates made for securing a gravity supply from South Mountain showed the plan to be too expensive, and the project has been abandoned.

New Holland, Pa.—George H. Rauch informs us that nothing is being done toward securing any other water supply.

Catonsville, Md.—Mr. Joseph M. Cone, President of the Catonsville Water Co., has sent us the following:

About 3 miles of 6, 4 and 3-in. mains will be laid this season, and 8 new valves will be set.

SOUTHERN.

Big Stone Gap, Va.—The Glamorgan Iron Works, of Lynchburg, Va., has been awarded the contract for constructing the new works. The contract price is $65,000.

Warrenton, Va.—An ordinance has been passed authorizing the construction of works. Address, J. A. Bethune.

Berkeley, Va.—It is reported that the Portsmouth & Suffolk Water Co. contemplates the construction of a water supply system.

Bedford, Va.—S. B. Mosby & Co., of Richmond are constructing a 1,000,000-gall. reservoir for the town.

Hinton, W. Va.—A charter has been granted to the Hinton Water-Works Co. The capital stock will be $20,000.

Albany, Ga.—The improvement Co. has applied for a 20-years franchise for constructing works.

Vienna, Ga.—The citizens have authorized Mayor Stovall to advertise for an election to vote on the question of issuing $10,000 of bonds for sinking an artesian well and erecting a system of works.

La Grange, Ga.—At a recent business men's meeting, J. G. Truitt was appointed Chairman of a Committee to

look into the cost of establishing works. Correspondence is solicited.

De Land, Fla.—The terms of the contract with Jesse W. Starr, of Philadelphia, call for 25 hydrants at an annual rental of $1,500; the city to have the privilege of purchasing the works at the expiration of 5 years and every fifth year thereafter at an appraised value. Two pumps of 1,000,000 and 250,000 galls. respectively, will be erected.

East Chattanooga, Tenn.—It is reported that H. A. Pevear, of Boston, Mass., is to put in a system of water supply.

Winchester, Ky.—Bids were received on May 15 for constructing works, by Mayor F. P. Pendleton. The town has recently voted to pay $3,000 per year for a water supply. The Winchester Water-Works Co. has been incorporated with a capital stock of $250,000.

Shelbyville, Ky.—A bill has passed the Legislature incorporating the Shelbyville Water-Works Co. to construct works.

Harrodsburgh, Ky.—A bill has passed the Legislature authorizing the city to issue $75,000 of bonds for constructing works.

Ashland, Ky.—Works will be built this year. Address the Ashland Improvement Co.

NORTH CENTRAL.

Cleveland, O.—The trustees will advertise for bids for the construction of a tunnel under the Cuyahoga River at the foot of St. Clair St. It is the intention to run two large mains through the tunnel which will carry a supply of water to the manufacturing districts in the eastern part of the city.

Conneaut, O.—We have received the following from J. R. Stenson:

It is now proposed to grant a franchise to reliable parties who would establish works, the question of bonding the city having been defeated by a citizens' vote on April 7. About 50 hydrants would be required. Estimated cost, $75,000. The proposed plan is to pump water from Lake Erie to a stand-pipe and reservoir. C. C. Williams is Chairmain of the Water-Works Board. Population 4,500.

Norwalk, O.—Another vote will probably be taken on the question of bonding the city for making extensive improvements.

Marion, O.—Water was turned into the mains for the first time on May 8. The fire test will be made on May 20.

Cincinnati, O.—The following engineers have been appointed a Board of Experts by the Board of Public Improvements to report upon the present needs to secure a sufficient supply of water: Charles Hermany, of Louisville, Ky.; J. J. de Kinder, of Philadelphia, Pa.; George Hornung, of Newport, Ky.; and J. N. Robinson, of Cincinnati.

—Five new pumping engines, each having a daily capacity of 5,000,000 galls., will be purchased at once and erected in the Front street pumping station. This action is taken by the Board of Public Improvements upon the recommendation of the board of exports. It is reported that two of the pumps will be purchased from the Maxwell Mfg. Co., of Hamilton, O., and three from the Corre Machine Works, of New York.

Xenia, O.—Superintendent G. T. Coyer informs us that the statement made in our issue of April 26, specifying improvements, etc., to be made this year, was incorrect. [We would say to our readers, as we have to Mr. Coyer, that the information as published was received by us over the signature of a reliable party.—EDITOR.]

Hudson, Mich.—Consulting Engineer J. D. Cook, of Toledo, O., engineer of the new works, has sent us the following list of bids, received on April 30:

For constructing complete works: P. C. Sheehan, Detroit, Mich., $28,963.14; John Seymour, Hudson, Mich., $30,209.69; J. C. Brooks, Jackson, Mich., $28 798; P. Keeting, Detroit, Mich., $30,284; Snyder & Williams, Dayton, O., $21,063.79; George C. Morgan, Chicago, Ill., $27,811.64.

For building only: Amasa Wilcox, Somerset Center, Mich., $4,672; P. Keeting, Detroit, Mich., $4,300; J. C. Brooks, Jackson, Mich., $4,336; L. B. Stevens, Toledo, O., $4,790.

Valves and Hydrants: J. C. Brooks, valves, $450.80; hydrants, $1,224; Rensselaer Mfg. Co., Troy, N. Y., valves, $460 and $484.10; Bingham & Taylor, Buffalo, N. Y., valve boxes, 4 in., $3 75; 6 in., $4.05; 8 in., $4.05; 10 in., $4.45; 12 in., $4.45; frost cases, $4.45 each; Galvin Brass & Iron Works, Detroit, Mich., $457.75; hydrants, gate hydrants, $1,224; compress hydrant, $1,377; Galvin Valve and Hydrant Co., Detroit, Mich., valves, $421; gate hydrants, $1,173; compress hydrant, $1,326; National Tube Works, McKeesport, Pa., valves, $506.79; Ludlow hydrants, $1,402.50; Frontier Iron & Brass Works, valves, $359.80; hydrants, $1,224; James Flower & Bro., Detroit, Mich., valves, $416.30; frost case, $27.50; hydrants, $1,402.50; R. D. Wood & Co., Philadelphia, Pa., valves, $486; hydrants, $1,672.80; Chapman Valve Mfg Co., Indian Orchard, Mass., valves, $507.08; hydrants, $1,680.96, with frost cases; $1,412.70, without; Bourbon Copper & Brass Works, Cincinnati, O., hydrants, $1,428, with frost cases; $1,377, without.

Furnishing Pumping Machinery and Boilers: Holly Mfg. Co., Lockport, N. Y., 1st engine, $3,088, $,588, $3,513; 2d engine, $2,832, $2,532, $2,613; complete boiler plant, $2,550. J. C. Brooks, Jackson, Mich., one engine, 2 boilers, complete plant, $5,900; Deane Steam Pump Co., Holyoke, Mass., one engine, $2,820, $2,450, $2,300, $1,950; $450 extra with condenser; L. B. Stevens, Toledo, O., boilers, $2,200, and $1,940. Gordon Steam Pump Co., Hamilton, O., one engine, $3,500, $3,100, $2,795, $3,775, $3,250, $2,885; omit $90 for steam jackets, if not wanted; complete boiler plant, $2,300; Eggleston Iron Works, Detroit, Mich., fittings, etc., $1,496.35; Geo. F. Blake Mfg. Co., boilers and complete plant, $8,000. Knowles Steam Pump Co., Boston, Mass., engines, $3,400, $2,850, $2,500, $2,800; complete boiler plant, $3,000. Henry R. Worthington, 1st engine, $2,650; 2d engine, $1,600, $2,120, $1,400; complete boiler plant, $2,060; Hughes Steam Pump Co., Cleveland, O., one engine, $2,573, $2,290, $1,658; $5,980, 1-C. A. C., 1 H. P., and 2 boilers; $3,658, 1-C. N. C., 1 H. P., no foundations and no boilers; Lansing Iron & E. Works, boilers and fittings, $1,300; Jackson F. & M. Co., boiler and fittings, $2,050; Porter Boiler Mfg. Co., Syracuse, N. Y., boiler and fittings, $1,140.

PIPE-LAYING.

BIDDERS.	4 in.	6 in.	8 in.	10 in.	12 in.	Totals.
	$	$	$	$	$	$
Slade & Brandon, Greenville, O..	0.25½	0.28	0.31	0 35½	0.41	7,425.95
Amasa Wilcox, Somerset Center, Mich.....	.15	.17	.21	.26	.31	4,680.44
R. B. Carothers, Newport, Ky..	.15½	.17	.21	.24	.26	4,643.69
J. J. Rumsey, Findlay, O.....	.16	.18½	.21¼	.25	.29½	4,913.47
J. C. Brooks, Jackson, Mich.	.15	.18	.22	.25	.28	4,783.46
L. B. Stevens, Toledo, O.....	.16	.18	.19	.28	.28½	4,863.26
Snyder & Williams, Dayton, O.....	.13	.16	.20	.26	.33	4,373.42
D. & J. Hardin, Chicago, Ill....	.22	.24	.34	.44	.49	6,956.48

FURNISHING PIPE AND SPECIAL CASTINGS.

BIDDERS.	4-in.	6-in.	8-in.	10-in.	12-in.	Specials.	Remarks.
Amasa Wilcox, Somerset Center, Mich.....	$23.97	.....	.....	.....	$?3.97	.....	$?4 per ton for specials laid.
Addyston Pipe & Steel Works, Cincinnati, O.	23.97	.....	.....	.....	23.97	$47.50	Contract awarded.
J. C. Brooks, Jackson, Mich.....	25.75	.....	.....	.....	25.75	46.67	
Lake Shore Foundry, Cleveland, O.....	25.65	.....	.....	.....	25.65	45.00	
Dennis Long & Co., Louisville, Ky.....	28.50	$27.00	.....	.....	27.00	55.00	
J. B. Clas & Sons, Chicago, Ill.....	27.87	.....	.....	.....	27.87	.....	
Warren Foundry & Machine Co., Phillipsburgh, N. J.....	29.90	29.25	.....	.....	29.25	Cts. per lb. 2⅝	
Jackson Woodin Mfg. Co., Berwick, Pa.....	36.30	34.80	$34.80	$34.30	34.30	2¼	Gross tons.
Donaldson Iron Co., Emaus, Pa.....	35.50	.....	.....	.....	35.00	2½	" "
Quantities (tons.....	101.84	207.36	56.10	58.50	36.90	11	

Milwaukee, Wis.—Several resolutions have been passed by the City Council providing for the laying of a considerable amount of new pipe. One has also been passed reading as follows:

That the City Engineer (George H. Benzenberg) be and is hereby authorized to prepare general specifications for a pumping engine and necessary boilers, said engine to be capable of pumping 18,000,000 galls. of water 160 ft. high every 24 hrs., and to be located in the engine-house at the North Point pumping works.

Further, That the Board of Public Works be and is hereby authorized to contract, pursuant to law, for such pumping engine and necessary boilers.

Oshkosh, Wis.—A third proposition has been made by an Eastern syndicate for the purchase of the existing works.

NORTHWESTERN.

Rock Rapids, Ia.—Work has been commenced.

Hawarden, Ia.—Contracts have been let for the construction of a new system of works, to be completed by Aug. 1.

Sioux City, Ia.—Engineers MacRitchie and Nichols, of Chicago, Ill., have been engaged to begin at once the preparation of plans and specifications for a new system of works.

A preliminary investigation has been made by John Nichol, C. E. In his address to the City Council he recommended that an entire new plant be put in at once. Water would first be conveyed from the Missouri River to large settling basins, thence pumped to a reservoir. The total estimated cost is $300,000. Provisions are to be made for furnishing a city of 200,000 inhabitants with water. The surveys will be made under the supervision of City Engineer Henry Wingeland.

Pittsburg, Kan.—The City Council has voted to extend and enlarge the privileges granted by franchise of the Pittsburg Water-Works Co. The works have just been sold to a syndicate. The funds are to be paid through the banking house of N. W. Harris & Co., of Chicago.

Canton, So. Dak.—The City Council has decided to open negotiations with parties desiring a franchise to put in a system of works. Better water facilities have become a necessity.

Fargo, No. Dak.—A report has been submitted to the City Council by Mr. Morrill of the Special Committee, recommending that a special election be held upon May 28 to vote upon the question of issuing $105,000 of bonds for constructing a new system of works, or purchasing the existing works and making such improvements, etc., as may be necessary to meet the demands of the city. Surveys will be made and plans and specifications for the new works will be prepared under the direction of the Special Committee. The following is taken from the Daily *Republican*:

The council should advertise for proposals to put in water-works, accompanied by proper bonds to ensure good faith. Advertise in New York, Chicago and St. Paul. Adopt the proposal most beneficial to the city. Call an election to vote bonds for such sum as is necessary. If carried, make the contract, sell the bonds, and put in the works. This is the ordinary business way of procedure, and gives the people full information at every step and full confidence that everything is right.

SOUTHWESTERN.

St. Louis, Mo.—Sealed proposals will be received at the office of the Board of Public Improvements until May 27, for making the required excavation and embankment and building Section A of the Low-Service Conduit (excepting the Terminal chamber) complete in working order.

For for further information see our proposal columns, or address Secretary, Emory S. Foster.

Austin, Tex.—The City Council has appointed a Water Board, to consist of ten citizens, who will have charge of the construction of the new works. Contracts will probably be let soon. Bonds for $1,400,000, bearing 4 per cent. interest, are now being offered for sale.

Rockdale, Tex.—Bids are wanted for constructing works. The officers of the Rockdale Water Co. are: R. H. Hicks, President, L. H. Porter; Vice-President, J. L. Lockett, Secretary. Water will be pumped to a stand-pipe.

Galveston, Tex.—A new pumping engine will be purchased at once.

Rocky Ford, Col.—E. C. Gobin has sent us the following information:

The contract for constructing works has been awarded to J. J. Brown by the city. The estimated cost is $7,000, procured by bonds, issued and sold. Water will be conveyed by gravity to a reservoir. C. D. Steward is Chairman of the Water Board. Engineer in charge, J. H. Randall. The works are to be completed in 90 days.

PACIFIC.

San de Fuca, Wash.—(A new town, on Whidby Island, near Portland, Ore.) The San de Fuca Land Co.'s engineer is devising plans for a system of works whereby the city will be supplied with fresh water, conducted in pipes, from a lake within two miles of the town. The present supply is from wells.

Livermore, Cal.—The Livermore Spring Water Co. is preparing to lay 3 miles of new 6 in. pipe to connect their upper reservoir with Positas Springs.

Riverside, Cal.—The Las Penasquitas Land & Water Co. has been incorporated. Capital stock, $150,000; all subscribed. The directors are: Orin Backus, W. H. Backus, J. D. McNab, J. Robinson McNab and Jacob S. Taylor.

San Bernardino, Cal.—Plans have been accepted by the city authorities for a new 1,000,000-gall. reservoir. Work will be begun at once.

Provo, Utah.—Bonds for $40,000 will be issued and sold to build works. The water supply will be brought from the Provo River, at the mouth of Provo cañon, 5 miles distant.

Ogden, Utah.—The contract for furnishing the iron-pipe for the city water system has been awarded to Smith & Co., of San Francisco. For the iron work on the wooden piping, to Rhodes Bros., and to F. M. Davis, of Denver, Col. Furnishing the redwood lumber, to Hooper & Co., of San Francisco.

Kalamein wrought-iron pipe will be used for all piping over 10 ins. in diameter, less than that kalamein steel. Thirty miles of piping will be laid in the distributing system.

CANADA.

Toronto, Ont.—Aldermen Maughan, McMullen, Gibbs and Small have been appointed committeemen to consider the question of water meters.—It has been decided to replace the No. 1 Worthington pumping engine with a new high-duty pumping engine of 8,000,000 to 10,000,000 galls. daily capacity.—The tender of John Perkins for stop valves has been accepted. The St. Lawrence Foundry has been awarded the contract for special castings. Charles Smith & Co. has received the contract for hydrant jackets. Matthew Warnock will make a 36-in. valve for the department at $833.

PROJECTS.

Waverly, Ia.—Humboldt, Neb.—Rockingham, N. C.—Ozark, Ala.—Shambaugh, Mich.; J. N. Porter, Village President.

FOREIGN.

City of Mexico, Mexico.—Press dispatches state that a heavy windstorm has blown down five arches of the aqueduct, and that the city is without drinking water.

ARTESIAN WELLS.

Sanford, Fla.—Several wells are being put down in different parts of the town.

Dakota.—Contracts have been let for sinking 6 wells in Spink County at an average of $1,600 each, on a basis of 1,000 ft. to each well.

Hall, Ia.—The old well has been abandoned. A new well is to be started.

IRRIGATION.

Denver, Col.—The Larimer and Wild Canal Extension Co. has filed a certificate of incorporation. It has a capital stock of $100,000, and will operate in Weld County.——The certificate of the Windsor Reservoir and Canal Co., of Weld County, has been filed with Secretary of State.

Montpelier, Idaho.—The Pioneer Irrigation Co. has been organized. Its object is to increase and properly distribute the water supply of Montpelier Creek. Stock to the amount of $40,000 has already been subscribed.

Salem, Ore.—The Middle Valley Irrigation and Water Ditch Co. has filed articles of incorporation. The object of the company is to irrigate the middle valley of Wallowa Co. Capital stock, $1,500. The incorporators are: E. A. Tully, B. O. Foster and Fred E. Parkyn.

Marysville, Cal.—The contract for the construction of a canal 26¼ miles long, in the Browns Valley Irrigation District, Yuba Co., has been let to Hamilton Gray, of San Francisco, at $69,546. Bonds have been sold and work on the canal is to be begun immediately. Water is to be taken from the Yuba River. About 45,000 acres are contained in the district.

Baker City, Ore.—A scheme to establish an irrigating district is proposed by Denver capitalists, and preliminary steps are being taken. The plan is to construct a large dam across the Powder River, to impound water to feed a canal 40 ft. wide by 8 ft. deep. About 100,000 acres of land would be reclaimed in the Powder River valley.

Ogden, Utah.—E. Mead, Consulting Engineer of the Bear River Canal Co., is reported as making the following statement:

Corey Bros., of Ogden, have been awarded the contract for building the two branches of the canal which is to irrigate the country west of the Bear and Malad Rivers. One branch of the canal will be built between the Malad and the Bear Rivers to Corinne; the other will cross the Malad and irrigate the country west of that river and extend toward Promontory.

Washington, D. C.—Senator Plumb has reported a bill for the suspension of the survey of irrigable lands and the substitution of a survey of the artesian basin in all the territory lying east of Montana and Colorado.——Major Powell's first report on irrigation has been issued. He estimates that the entire survey can be completed in six years at an estimated cost of $6,000,000. This will cover the location and survey of all reservoirs and canals, and of all irrigable lands and the designation of all lands that should be irrigated for settlement. During the past year 30,000,000 acres of such lands have been selected, and 127 reservoir sites designated, measuring 2,600 square miles. About 43,000 square miles have been surveyed and mapped at a cost of less than $4 per mile.

SEWERAGE AND MUNICIPAL.

Water Power.—At Seattle, Wash., surveyors have demonstrated that the waters of Lake Mason can be successfully used for manufacturing purposes in Detroit, a fall of 80 feet being obtained at the latter place. In consequence of this discovery several large manufacturing enterprises are sure to be started at Detroit.

At Austin, Tex., an election was held May 5 for the taxpayers to decide whether the city should undertake the building of a granite dam 60 ft. high across the Colorado River, thus securing 14,000 H. P. at a cost of $1,500,000. Only property owners voted and the Australian system was adopted. There were 1,350 votes cast for the dam and only 53 against it.

Street Work.—At Chelsea, Mass., a committee of the council recently visited the territory lying between Washington Ave. and Powder Horn Hill for the purpose of investigating and considering the advantages of laying out a series of streets over this extensive tract which lies in the midst of the residential portion of Chelsea. A petition was presented to the board of aldermen some time ago, requesting that an avenue, to be called Garfield Ave., be struck across this territory, which at present is a great expanse of pasturage, against which are backed up the grounds of many fine estates.

At Trenton, N. J., a street paving bill has been passed in the Senate. The bill is to take effect immediately.

The City Council of Monongahela City, Pa., is investigating and experimenting with asphalt pavements with a view to laying this kind of pavement upon all of its principal streets.

At Urbana, O., an ordinance has been passed providing for street paving.

The Board of Public Works, St. Paul, Minn., has let the contract for building all the stone sidewalk ordered constructed in 1890 to Thomas W. Breen at the approximate amount of $14,873. There were three other bidders, whose approximate amounts were as follows: Lawer Bros., $15,266.50; William H. Ulmer, $15,152.20; Charles Stone, $13,915. The contract for grading the west side levee from block 6 in Banning & Olivier's addition to Starkey St., a distance of nearly one mile, was let to Norton & Shaw at $21,900.

Mr. W. S. Wilkinson, President of the International Paving Co., of New York, has been to Portland, Ore., recently to get up a company to engage in laying sheet and block asphalt pavements, and it is probable that a company will be formed here to control the business for the whole Pacific coast.

The estimates of the Board of Works, of Toronto, Ont., are as follows: Roadways, $62,000; sidewalk repairs, material and labor, $30,000; labor cleaning culverts, $15,000; street tablets and numbering, $200; street cleaning, $90,000; plant and repairs to plant, $8,000; sewers, $40,800; dredging Yonge St. and other slips, $3,500; repairs and reconstructing stone and wooden kerbs, $10,000; wooden and stone kerbs, $2,000; planking and maintenance of bridges, $7,200; Frederick St. wharf, $3,500; stone crossings, $15,000 Total, $284,200.

Sewerage.—Sewers are to be built in the Second Ward at Holyoke Falls, Mass. The cost will be paid by the residents.

At Rochester, N. Y., the Upton Park, University Ave. and Beacon St., pipe sewer on the east side has been completed by the contractor, R. Y. McConnell. This sewer includes a stone sewer in Beacon St., 900 ft. long, 2 ft. by 2 ft. 6 ins., with brick invert and 12 ft. deep, cut 3 ft. into the rock; also a 24-in. pipe sewer in Upton Park, 700 ft. long and 10 ft. deep. All lot laterals from the abutting property are connected.

At Clifton, O., an ordinance has been passed providing for the issue of bonds for $50,000 for sewerage.

The intercepting sewer at Columbus, O., is being built by L. C. Newson. It consists of sewer pipe 2 ft. diameter, and brick sewer, 2½ ft., 3 ft. and 4½ ft. diameter.

At West Knoxville, Tenn., the West Knoxville Sewer Co. has been incorporated by D. A. Carpenter, G. L. Maloney, J. W. Yoe, Samuel Manfield and J. Thornburgh; The purpose of the company is building sewers for West Knoxville. It is to have privileges of constructing the main sewers in the streets free of cost. The source from which they expect to reap their profits is from the privilege tax from property owners who will be compelled by the city to tap the the main line. The price for this is set by the city council.

Proposals for the construction of sewers at Talladega, Ala., will be opened May 19, by W. H. Skaggs.

The Council Committee on Sewers, of Armourdale, Kan., paid the South side a visit recently to consider the feasibility of constructing a sewerage system. The chairman of the committee said that the committee would no doubt present an adverse report to the council, as the Sixth Ward taxpayers consider that it will require too much money to build the system this season. The ordinance, which is now before the council for passage, provides for the erection of a pumping station and a sewer system. The cost of the system will be taxed up against the property owners in this district and the City Engineer estimated that it would cost at least $18 per lot to pay for the improvement.

ELECTRICAL.

Electric Lighting.—The Selectmen of Revere, Mass., have made a contract for 3 years with the North Shore Electric Light Co., to furnish 15 arc lights of 1,200 c. p., to burn 275 nights in the year, from one-half hour after sunset till 12:30, at $72 per light per year; and 175 incandescent lights to burn the same length of time at $16 per light per year.

The electric light company at Worcester, Mass., has made a proposition to the Street Lighting Committee to furnish light for one year at 55 cents per light per night, for three years at 50 cents, for five years at 45 cents.

The Street Lighting Committee of Cohasset, Mass., has decided to contract for 150 electric lights at $20 per light.

At Corning, N. Y., a contract for 5 years has been made with the Corning Gas Co., to furnish 50 arc lights (Thomson-Houston system) at $100 per light per year.

At Newark, Del., a petition has been circulated to have Council order a special election of all property holders to decide whether or not the town shall be further bonded to raise money to erect and operate an electric light plant for the lighting of the streets, and incidentally the illumination of stores and private residences.

At St. Albans, W. Va., an electric light franchise has been granted to R. T. Ovey.

At Cedartown, Ga., a contract has been made with M. Davie to furnish 30 arc lights at $1,600 per annum.

At Gainesville, Ga., it is proposed to issue bonds for $10,000 to purchase the plant now operated by the Gainesville Light Co.

The Ball system of electric lighting for streets and buildings is to be put in at Jacksonville, Fla.

The Citizens' Electric Light & Power Co., of Montgomery, Ala., has been organized as follows: President, P. B. Bibb; Secretary, W. H. Gesner. The Ball system will probably be adopted.

The Youngstown Electric Light Co., of Youngstown, O., will soon have an incandescent light plant in operation. A contract has been made with the Westinghouse Co., of Pittsburg, for five dynamos and other electrical apparatus.

The Bridgeport Electric Light & Power Co. has awarded a contract for plant to the Fort Wayne Electric Co.

At Lebanon, Mo., an electric light franchise for 20 years has been granted to B. F. Hobart, of St. Louis. The city will take 23 arc lights.

The City Council of Falls City, Neb., will advertise for bids for establishing an electric light plant.

An electric light company has been organized at Lewiston, Idaho. President, W. E. Kittenbach; Vice-President, C. J. Smith; Secretary, F. W. Kittenbach. Capital stock, $30,000.

Propositions for electric lighting will be received by R. L. Porter, mayor, Greenville, Tex.

BRIDGES, TUNNELS, AND CANALS.

Bridges.—*Hampton Ferry, Neb.*—The present bridge across the Kennebeccasis River will probably be replaced by an iron structure soon.

Bradford, Pa.—The contract for building the 60-ft. span pony truss bridge at this place has been awarded to the Massillon Bridge Co., of Massillon, O., for $2,750. The contract for the masonry was awarded to the King Bridge Co. at $6.32 per cu. yd.

Elizabeth, Pa.—The Elizabeth Bridge Co. has been organized to build a bridge over the Monongahela River at this place.

Harrisburg, Pa.—The Philadelphia & Reading R. R. Co. has awarded the contract for its bridge across the Susquehanna River at Harrisburg, to the Phœnix Iron Co., of Phœnixville. The structure will be 4,500 ft. long, with 23 spans and approaches, and will cost $300,000. The bridge will be completed by January 1.

Wheeling, W. Va.—Jolly Bros. have been awarded the contract to build the substructure of the bridge from Wheeling to Wheeling Island and from thence to Etnaville, O. The cost of the stone work is $145,000 and the total cost $552,000.

Burlington, Ia.—The wagon bridge project is again being agitated in Burlington. It is now proposed to vote a 2¼ per cent. tax instead of 5. If this carries about $60,000 will be raised in stock among the stockholders and $40,000 among other residents. It is thought a 2½ per cent. tax would carry.

Portland, Ore.—The Portland Bridge & Building Co., of Portland, Ore., has been chartered with a capital stock of $30,000. Among the incorporators are: Geo. W. Martin, Robert Wakefield and T. D. Warwick.

CONTRACTING.

Street Work.—The District Commissioners, at Washington, D. C., have awarded the contract for grading and improving Pennsylvania Ave., to Andrew Gleason, at $20,000.

The Board of Public Works, Knoxville, Tenn., has awarded a contract for macadamizing the streets to Peyton Carter, at $1.35 per cu. yd.

At Peoria, Ill., contracts have been awarded as follows by the Street Committee: T. W. Marshall & Co., Chicago, $11,019.84, $14,926.73, $16,997.67; Martin McDonald, $5,629.38, $6,077.50: P. W. Harmon, $7,423.35, $7,975.72, $11,833.94. John Bassler, Galesburg, $38,979.39.

Among the contracts for street improvements awarded recently, by the Board of Public Improvements, St. Louis, Mo., were the following: Improving Morgan St., between Vandeventer and Grand Aves., $16,997.45. Fruin-Bam brick Contracting Co.; improving Washington Avenue, from Pendleton to Taylor Ave., $15,400.40, W. H. Barnett.

At Plattsmouth, Neb., the contract for paving Sixth St. has been awarded to J. E. Riley, of Omaha, at $2.29 per sq yd.

At Mt. Ida, Ark., a contract for paving Mesa Ave. has been let to Hendrick & Satterwhite, at $7,365.16.

Asphalt Paving.—The Board of Public Works, Detroit, Mich., has received the following bids for asphalt paving on Warren Ave. and Ferry Ave.: Warren-Scharf Asphalt Paving Co., $2.84 per sq. ft.; Western Paving & Supply Co., $2.79½ for foundation and paving, exclusive of curbing. The amount will be about $60,000.

Paving Blocks.—At Fall River, Mass., the contract for granite paving blocks has been awarded by Anthony Thurston, Superintendent of Streets, to the Fall River Granite Co., at $100 per 1,000 (delivered) for large, and $50 per 1,000 for small or track blocks. The Millstone Granite Co., of Millstone, Conn., bid $110 and $90 per 1,000 for large and small blocks respectively. The contract is for 200,000 blocks, 3½ to 4 ins. wide, 12 to 14 ins. long, 7½ to 8 ins. deep; 70,000 blocks for paving between the rails of the street railway tracks, 3½ to 4 ins. wide, 5 to 8 ins. long, 5 to 6 ins. deep. All of the edges to be sharp and straight, forming right angles at their intersections, both horizontally and vertically. The faces to be straight split and free from bunches or depressions, each and every block to be in all respects satisfactory to the Superintendent of Streets.

Sewers.—*Boston, Mass.*—The following tables give the prices of sewer contracts recently awarded. Table No. 1 gives contracts for main sewers awarded by the Metropolitan Sewerage Commission. Section No. 3, Deer Island, was awarded to R. A. Malone & Co., of Philadelphi, Pa. Sections Nos. 4, 5 and 6, Winthrop, were awarded to the Metropolitan Construction Co. Section No. 3 comprises the outlet of the sewer and its construction on Deer Island spit, which reaches about one-half mile from the shore of Deer Island. Section No. 4 takes in the pumping station on Deer Island. Shirley Gut lies between Sections Nos. 5 and 6. The next parts of the work to be let, and already advertised, are Sections A and B of the Charles

River valley sewer, in the town of Brookline. Table No. 2 gives contracts awarded May 7 by the City Engineer, as follows: Section No. 4, Dorchester intercepting sewer, Collins & Ham, Boston; Section No. 5, Dorchester intercepting sewer, H. P. Nason, Boston; Section No. 7, South Boston intercepting sewer, Perkins & White, Boston. For Section No. 7, West side intercepting sewer, the contract was not awarded. The only bid was from E F. Brigham, of Cambridge, concrete masonry, $5.70 per cu. yd.; manholes, $50 each; 6-in. drain pipe, 40 cts. per lin. ft.; 15-in. pipe sewer, $7.58; tide gate chamber and sump manhole, $400; total, $5,053.

TABLE No. 1.

ITEMS.	Section No. 3.	Section No. 4.	Section No. 5.	Section No. 6.
Earth excav. and refilling, lin. ft.	$14.00	$11.09	$10.05	$9.12
Relaying Winthrop 18-in. sewer, lin. ft.	.....	.65	.65	.....
Rock excav., cu. yds.	4.00	5.00	5.00	5.00
Brick masonry, American cement, cu. yds	11.00	12.83	12.95	13.14
Brick masonry, Portland cement, cu. yds.	12.00	14.75	14.85	15.00
Concrete masonry, American cement, cu. yds.	5.50	3.85	4.30	4.95
Concrete masonry, Portland cement, cu. yds.	6.50	5 54	5.94	6.59
Spruce lumber in place, 1,000 ft. B. M.	20.00	27.00	27.00	27.00
6-in. under-drain in place, lin. ft.	60	.20	.20	.20
8-in. under-drain in place, lin. ft.	.70	.25	.25	.25
10-in. under-drain in place, lin. ft.	.80	.34	.45	.34
12-in. under-drain in place, lin. ft	1.00	.50	.60	.50
Spruce piles, driven, lin. ft.	.30	.13	.13	.13
Cobblestone paving, sq. yds.	1.50	.30	.30	.30
Earth excav. and refilling outside of trench, cu. yds.	.80	1.25	1.25	1.25
Total	$74.297	$138.222	$136,931	$98,085

TABLE No. 2.

ITEMS.	Section No. 4.	Section No. 5.	Section No. 7.
Earth excav. and refilling in trench, lin. ft.	$4.40	$3.85	.....
Brick masonry, American cement, cu. yds.	7.25	12.80	.....
Brick masonry, Portland cement, cu. yds.	15.00	15.00	.....
Concrete masonry, cu. yds.	4.50	5.00	5.38
Rubble stone masonry, cu. yds	5.25	4.50	.....
Dimension stone masonry, cu. yds	65.00	.....	.....
Manholes, each	.....	.....	38.00
Spruce lumber, 1,000 ft. B. M.	23.00	26.00	.....
10-in. drain pipe, lin. ft.	0.40	0.50	.....
6-in. under-drain, " "	.....	.....	0.15
Rip-rap, cu. yds	4.00	4.00	.....
15-in. pipe sewer, lin. ft.	.....	.....	1.83
Tide-gate chamber and sump manhole, complete	.....	.....	330.00
Total	$23,621	$24,592	$6,967

PROPOSALS OPEN.

Street Work.—Grading and cobblestone paving on Moffat St. J. P. Adams, Commissioner of City Works, Brooklyn, N. Y. May 20.

Street Work.—Granite block pavement and 20-in. curbing. The Contracting Board, Troy, N. Y. May 20.

Pipe.—Cast-iron water pipe; 2,000 lin ft. of 4-in., 1,000 ft. of 6-in., 5,000 lbs. of specials. Jos. Ecoff, Superintendent of Water-Works, McKeesport, Pa. May 20.

Sewers.—Pipe sewers 12 and 15-in. pipe; 20 x 30 in. brick sewer, manholes and basins. Ernest Adams, City Surveyor, Newark, N. J. May 20.

Rock.—About 30,000 tons of rock, 35 per cent. not less than 1 cu. yd. in size, 40 per cent. ½ cu. yd., 25 per cent. 1-20 cu. yd. Galveston Wharf Co., Galveston, Tex. May 20.

Seawall.—At Key West, Fla. N. H. Farquhar, Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C. May 21.

Sewers.—Sewers, catch-basins and manholes. The Board of Public Works, St. Paul, Minn. May 22.

Sewers.—Vitrified pipe sewers. Engineer W. E. Worthen, 63 Bleecker St., New York, N. Y. Geo. C. Appell, Chairman of Sewer Committee, Mt. Vernon, N. Y. May 23.

Machinery.—Shafting, belting, etc. Col. F. H. Parker. U. S. A., Watervliet Arsenal, West Troy, N. Y. May 23.

Building.—The U. S. building at Camden, N. J. Jas. H. Windrim, Engineering Architect, Treasury Department, Washington, D. C. May 26.

Sewer Work.—Reconstruction of concrete of that portion of the Main Lake sewer lying between the east line of Broadway and the inlet at Lake Merritt in the City of Oakland. The work consists of the construction of a foundation of concrete and piling, where necessary, and constructing thereon a sewer of concrete of the dimensions corresponding with the brick portion, and constructing two manholes and eight catch basins, with lateral connection and conduit pipes. Plans and specifications on file. The Board of Public Works, Oakland, Cal. May 27.

Viaduct.—Framed bents and pile foundation, 13 spans, 20 ft. roadway. Geo. H. Simpson, City Engineer, Terre Haute, Ind. May 30.

Brick.—From 1,000,000 to 12,000,000 hard body brick for sewers. The Commissioner of Public Works, Providence, R. I. May 30.

Terra-Cotta.—Brick and terra-cotta floor arches, furring, partitions, etc. J. H. Windrim, Supervising Architect, Treasury Department, Washington, D. C. May 30.

Boilers.—Boiler plant at the city workhouse. W. C. Muller, Secretary of the Workhouse Directors, Cincinnati, O. May 31.

Water-Works.—On franchise plan, 55 hydrants. A. M. Parsons, Chairman, Light and Water Committee, Somerset, Ky. June 1.

Street Work.—About 196,000 sq. yds. hard burned brick or cedar block paving; also, 65,000 lin. ft. of curbing. Plans and specifications on file in the office of Henry Wingeland, City Engineer. Thomas Malone, Chairman of Paving Committee, Sioux City, Ia. June 3.

MANUFACTURING AND TECHNICAL.

Water Meters. Last week there were tested and delivered two 10-in. Gem meters, manufactured by the National Meter Co. for the city of Chicago, to measure the water delivered to the town of Pullman, Ill., by that city. The test was made in the presence of Supt. Baker, of the Chicago Water-Works, and Gen. Porter, the representative from Pullman, and was perfectly satisfactory to all parties concerned. The system of selling water in quantities by one city to another is quite in vogue, and this company has manufactured a number of 10-in. meters for that purpose, as well as a large number of other sizes, as the TREE in its advertisement on page 13 of this issue indicates.

The Mellert Foundry & Machine Co., of Reading, Pa., has patented improvements on its design of fire hydrant which was patented in 1888.

Water Motors are wanted by R. L. Jennings, of Marshall, Tex.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have delivered 5 ten-wheel freight engines to the Savannah, Florida & Western, and 3 passenger engines to the Alabama Great Southern. They have an order for 31 engines for the Union Pacific.

The Schenectady Locomotive Works, of Schenectady, N. Y., have an order for 75 engines for the New York Central; 21 eight-wheel passe ger engines, cylinders 19 × 24 ins.; 25 mogul freight engines, cylinders 19 × 26 ins.; 29 eight-wheel switch engines, cylinders 18 × 24 ins. They have an order for 15 engines for the Louisville, New Orleans & Texas.

The Rhode Island Locomotive Works, of Providence, R. I., are building 10 engines for the Georgia Southern & Florida. and 71 for the Union Pacific.

The Manchester Locomotive Works, of Manchester, N. H., are building 6 ten-wheel freight engines for the Boston, Concord & Montreal.

The Pittsburg Locomotive Works, of Pittsburg, Pa., have completed five heavy passenger engines for the Vandalia, Terre Haute & St. Louis. Two are for the Terre Haute & Indianapolis division, and three for the St. Louis division. All are equipped with elelectric head lights.

H. K. Porter & Co., of Pittsburg, Pa., have completed two locomotives for running inside coal mines. One of these is for West Virginia, weighs about 5 tons, and is 5 ft. high. The other locomotive weighs about 16 tons, and is only 6 ft. high; it goes to Pocahontas, Va. They have also completed a small gauge engine for hauling lorries on top of coke ovens, and a mogul locomotive of 30-ins. gauge for a plantation in Cuba.

The plant of the Portland Company, an old established manufactory of locomotives and steam engines at Portland, Me., has been sold to a syndicate of Portland men, composed of C. R. Milliken, W. L. Putnam, W. F. Milliken, Elias Thomas, W. T. Dunn, D. W. Kensell, C. S. Forbes and others. The price paid was par. The purchasers are to receive the May dividend.

The Chicago, St. Paul & Kansas City has ordered 25 tenders for locomotives.

Cars.—The Pullman Palace Car Co., of Chicago, Ill., is building passenger cars for the Delaware, Lackawanna & Western. They are lighted by compressed gas, on the Pintsch system.

The Wagner Palace Car Co., of Buffalo, N. Y., is building 8 parlor cars for the Central Vermont.

The Laconia Car Co., of Laconia, N. H., has an order for 25 platform cars of 50,000 lbs. capacity for the Barre road.

The Haskell & Barker Car Co., of Michigan City, Ind., has a contract for 150 box cars for the Evansville & Terre Haute; also for 1,000 box cars for the Chicago, St. Paul & Kansas City.

The New York Equipment Co., of New York, N. Y., has an order for 50 ventilated fruit cars of 50,000 lbs. capacity, and 150 platform cars, for the Alabama Midland. The contract amounts to $56,000.

McKee, Fuller & Co., of Catasauqua, Pa., have an order for 1,500 box cars of 50,000 lbs. capacity for the Lehigh Valley.

The Lafayette Car Works, of Lafayette, Ind., are building 40 ore cars for the Duluth & Iron Range

The Ensign Car Works, of Huntington, W. Va., have a contract for 300 box cars for the Cleveland, Chicago, Cincinnati & St. Louis.

The Jackson & Woodin Car Co., of Berwick, Pa., has an order for 500 box cars of 50,000 lbs. capacity for the Lehigh Valley.

The Fall Brook Coal Co. will add 400 freight cars to its equipment.

The Huntington Electric Ry. Co., of Huntington, W. Va., will purchase 2 two-horse cars and 2 one-horse cars.

The Maine Central R. R. has built a new U. S. mail car at its Waterville shops. The car is 60 ft. long

The Steel Tubular Car Co., which builds cars with frames built up of steel tubes, has purchased 5,000 acres of land for car works near Bradford, Pa.

The Steel Rail Supply Co., of 10 Wall Street, New York, N. Y., will furnish, on the installment plan, steel rails of all weights, together with the requisite fish-plates, bolts and square nuts, and the necessary spikes to lay same. The title to the track material remains with the company till the last payment is made; transfer of title will be given. Payments can be anticipated, if desired. Estimates will be furnished on application, for not less than one mile of track, and only per mile of single track, complete. President, M. P. Sayce; Secretary, G. H. Humphreys.

Signals.—The Kelsey Railroad Signal Co., of Florence, Mass., has closed a contract with the New York Central & Hudson River R. R. to equip the Fourth Ave. tunnel in New York City with its patent automatic gong. These are to be set 300 ft. from each home signal and give one stroke as the engine strikes them, warning the engine driver to be on the lookout for the signal. They are especially valuable in times when fog and smoke may make the engineer uncertain of the exact location of the signals.

Tie Plates.—A new tie plate, for use on railway ties, has been brought out by Henry J. Case, of Auburn, N. Y. The invention is said to "cover all practicable forms of flanges, that can be readily manufactured that it will so engage the wood that an absolutely immovable and permanent hold can be secured in the tie, which is a condition necessary to the effective service of the plate, and without which any device of the kind will shorten the wearing life of tie instead of prolonging it."

Pipe Cutter.—The "Eureka" pipe cutter, manufactured by W. C. Codd, 2010 Aliceanna St., Baltimore Md., has an adjustable and renewable cast-steel jaw at the point of contact with the pipe. The wheel-block is also of cast steel. This pipe cutter is made of three sizes, cutting from ⅛ in. to 1 in. pipe, ⅜ in. to 2 in., and 1 in. to 3 in. New jaws can be easily fitted, and at small cost.

Asphalt Paving.—The Wehn Pavement Co., 16 Exhange Place, New York, has a contract to construct the artificial stone platform and sidewalks in and around the new Grand Central Depot of the Wisconsin Central R. R. in Chicago. The four platforms in the depot, each about 600 ft. long, are to be entirely constructed of "Lithogen" artificial stone; also the waiting room, drive-way and sidewalks around the depot. It is said that the platforms and approaches will compare favorably with the general magnificence of this new addition to the railway buildings of Chicago. The company is also engaged on considerable work for the Pittsburg, Fort Wayne & Chicago and Pennsylvania roads. Its specialty is railway work, such as station platforms, floors, car shops, round houses, etc.

Road Roller.—An Aveling & Porter steam road roller has been purchased of W. C. Oastler, of New York, for the construction of the roads in the new park at Pittsburg, Pa. Ground has been broken for this park, which will have an area of 400 acres, 300 being a gift to the city. The City Council has appropriated $200,000 for this year's work.

Metal Market Prices.—*Rails*—New York: $31, old rails, $23.50 to $24 for iron, $19 to $19.50 for steel. Chicago: $35; old rails, $22.50 for iron, $19 to $20 for steel. Pittsburg: $31 to $31.50; old rails, $23.50 to $24.50 for iron; $21 to $22 for steel.

Track Materials.—New York: steel angle bars, 1.75 cts.; spikes, 2 to 2.10 cts.; track bolts, 2.05 to 2.10 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.80 to 1.90 cts. for iron; spikes, 2.05, or 2.15 cts. delivered at Chicago or St. Louis; track bolts, 2.85 to 2.90 cts., with square, and 2.95 to 3 cts. with hexagon nuts. Chicago: splice bars, 2.10 to 2.20 cts. for steel, and 1.95 to 2.05 cts. for iron; spikes, 2 cts.; track bolts, 2.85 to 3 cts., with hexagon nuts.

Pipe.—Cast-iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded, 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York 4.10 cts.; Chicago, 3.85 to 3.95 cts.; St. Louis, 3.75 cts.

Structural Material.—Pittsburg: angles, 2.25 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared steel bridge plates, 2.75 cts.; universal mill plates, 2.40 cts.; refined bars, 1.90 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire box; 3.15 to 3.20 cts. for flange; 3 cts. for shell, 2.90 cts. for tank.